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PROCESSES, PROCEDURES, AND METHODS TO CONTROL POLLUTION RESULTING FROM ALL CONSTRUCTION ACTIVITY

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air and Water Programs
Washington, D.C. 20460

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FOREWORD

This report is issued in response to Section 304(e)(2)(C) of Public Law 92-500. This Section provides:

> The Administrator (Environmental Protection Agency), after consultation with appropriate Federal and State agencies, and other interested persons, shall issue to appropriate Federal agencies, the States, water pollution control agencies, and agencies designated under section 208 of this Act, within one year after the effective date of this subsection (and from time to time thereafter) information including . . . (2) processes, procedures, and methods to control pollution resulting from --
>
> "(C) all construction activity, including runoff from the facilities resulting from such construction;"

It provides information of a general nature regarding processes, procedures, and methods for controlling erosion and sediment deposition, stormwater, and pollutants other than sediments which result from all construction activity. It is intended to act as a state-of-the-act document useful for the development of effective programs to control non-point source pollution.

Russell E. Train
Russell E. Train
Administrator
U.S. Environmental Protection Agency

CONTENTS

SECTION PAGE

ACKNOWLEDGMENTS ---------- ii
PREFACE ---------- xii
I SUMMARY ---------- 1
II CONCLUSIONS ---------- 3
III INTRODUCTION ---------- 8
IV SITE PLANNING ---------- 15
  OVERVIEW ---------- 15
  GENERAL PRINCIPLES OF PLANNING AND DESIGN ---------- 19
  HYDROLOGIC AND HYDRAULIC CONSIDERATIONS ---------- 25
  VEGETATIVE CONSIDERATIONS ---------- 26
  USE OF PLANNING TOOLS ---------- 28
  WATER POLLUTION ABATEMENT PLAN ---------- 31
V EROSION CONTROL ---------- 41
  OVERVIEW ---------- 41
  METHODS OF CONTROL ---------- 47
  STRUCTURAL DESIGN & CONSTRUCTION ---------- 61
  VEGETATIVE DESIGN ---------- 64
  EFFECTIVENESS ANALYSIS ---------- 67
VI SEDIMENT CONTROL ---------- 71
  OVERVIEW ---------- 71
  METHODS OF CONTROL ---------- 72
  DESIGN, CONSTRUCTION, AND OPERATIONAL CONSIDERATIONS ---------- 81
  MAINTENANCE ---------- 84
  EFFECTIVENESS ANALYSIS ---------- 86

VII POLLUTANTS OTHER THAN SEDIMENT 89
  OVERVIEW 89
  PESTICIDES 92
  NUTRIENTS 93
  SOLID WASTE 94
  CONSTRUCTION CHEMICALS 95
  PETROLEUM PRODUCTS 96
  OTHER POLLUTANTS 96
VIII STORMWATER MANAGEMENT 101
  OVERVIEW 101
  METHODS OF CONTROL 111
  WATERSHED PLANNING 123
  DESIGN 126
  MAINTENANCE 127
IX INSTITUTIONAL PROCESSES AND PROCEDURES RELATIVE TO THE CONTROL OF POLLUTANTS RELEASED DURING CONSTRUCTION 130
  OVERVIEW 130
  EVOLUTION OF RELEVANT POLLUTION CONTROL LAWS AND DIRECTIVES 134
  COORDINATION OF PLANS & CONTROLS 146
  RECENT LEGISLATIVE APPROACHES 156
  INSTITUTIONAL DECISION-MAKING PROCEDURES 160
X APPENDICES 168
  A. SOIL ERODIBILITY NOMOGRAPH 169
  B. SPECIAL NOTES RELATIVE TO THE WATER POLLUTION ABATEMENT PLAN 170
  C. APPROVAL AND CERTIFICATION STATEMENTS RELATIVE TO THE WATER POLLUTION ABATEMENT PLAN 171
  D. JOINT MEMORANDUM BETWEEN THE U.S. DEPARTMENT OF THE INTERIOR & THE STATE OF NEVADA 173

E. SOIL EROSION AND SEDIMENT CONTROL ACTS ------------- 181

MODEL STATE ACT

PENNSYLVANIA'S CLEAN STREAMS LAW

MICHIGAN'S SOIL EROSION AND SEDIMENT CONTROL ACT

FIGURES

PAGE

III-1 Construction site lacking structural and vegetative soil stabilization measures for controlling erosion, runoff, and sedimentation ---------------------------- 11

III-2 Sediment deposited in a wooded area threatening survival of specimen trees --------- 11

III-3 Turbidity plume entering a waterway as stormwater runoff from a construction site ---------------------------------- 12

III-4 Sediment deposited along a waterway downstream from highway fill ---------------- 12

IV-1 Aerial view typical of many suburban housing developments -------------------------- 15

IV-2 Aerial view typical of urban transportation networks ------------------------------ 16

IV-3 Aerial view typical of suburban land-clearing for highways and other facilities ---------- 16

IV-4 Excavation and construction for a large-scale electric power plant ---------------- 17

IV-5 Embankment for dam construction -------- 19

IV-6 Excavation area relative to dam construction ------------------------------------ 20

IV-7 Stream fording or crossing areas need protection ---------------------------- 24

IV-8 Dredging operations and spoil disposal---- 24

PAGE

IV-9 Terracing across steep slopes along highways to reduce runoff, prevent soil slippage, and aid plant growth ---------------------- 27

IV-10 Use of staging or phasing of vegetative soil stabilization practices along highway cut slopes ---------------------------------- 33

IV-11 Use of staging or phasing of vegetative soil stabilization practices along an access road ------------------------------------ 33

V-1 Water concentrating in rivulets ------------ 43

V-2 Gullies formed in unstabilized slope -------- 44

V-3 Stream channel erosion ------------------- 44

V-4 Properly scarified cut slope to control runoff ---------------------------------- 48

V-5 Typical diversion structures--------------- 49

V-6 Interceptor dike on a graded right-of-way -- 50

V-7 Flexible downdrain ---------------------- 51

V-8 Sectional downdrain--------------------- 52

V-9 Temporary flume made of concrete ------- 53

V-10 Level spreader-------------------------- 53

V-11 Temporary vegetation using annual rye grass ---------------------------------- 54

V-12 Herbaceous plants, shrubs, and trees stabilizing slope------------------------ 55

PAGE

V-13 Application of grass seed on graded slope ---------------------------------- 56

V-14 Crown vetch (perennial legume) applied to steep stream bank slopes ---------------- 56

V-15 Temporary netting on a roadway ditch ----- 57

V-16 Streambank protected by stone rip-rap ----- 59

V-17 Gabion check dam and bank protection------ 59

VI-1 Planning for the preservation of a natural vegetative buffer ------------------------ 73

VI-2 An installed buffer between an exposed graded slope and a waterway-------------- 74

VI-3 Sod inlet filter ------------------------- 75

VI-4 Gravel inlet filter ----------------------- 76

VI-5 Sand bags placed across a small drainageway -------------------------- 77

VI-6 An excavated sediment trap -------------- 77

VI-7 A "dry basin" partially filled with sediment ------------------------------- 78

VI-8 A "wet basin" trapping sediment ---------- 79

VI-9 An interceptor dike impounding runoff and diverting it to gravel inlet filters--------- 80

VIII-1 Runoff from an impervious parking lot----- 103

VIII-2 Hydrographs of study area showing various stages of development ------------------ 104

PAGE

VIII-3 Collapsed streambank caused by undercutting -------------------------- 107

VIII-4 Concrete-lined channel------------------ 107

VIII-5 Stormwater management in stream channel ------------------------------- 108

VIII-6 Unit hydrograph (dashed line) showing stormwater management applied to study area--- 109

VIII-7 Rooftop ponding ------------------------ 112

VIII-8 Stormwater detention structure in remote portion of a parking lot ----------------- 112

VIII-9 Playground designed for temporary storage of runoff ---------------------------- 114

VIII-10 A diversion structure adjacent to highway-- 114

VIII-11 Perforated lawn to increase infiltration---- 115

VIII-12 "Blue-green" concept in the urban area---- 116

VIII-13 An aesthetical and functional detention basin blending in with character of landscape---- 117

VIII-14 Poorly controlled and maintained detention basin---------------------------------- 117

VIII-15 Infiltration system collecting runoff from parking lot ---------------------------- 119

VIII-16 FABRIFORM® check dam ---------------- 121

VIII-17 Permanent lake with available capacity to detain excess runoff ------------------- 122

VIII-18 Temporary storage impoundment along roadway ------------------------------ 122

PAGE

VIII-19 Areal system of control ----------------- 124

VIII-20 Linear system of control ---------------- 124

VIII-21 Outlet of a detention basin in need of maintenance --------------------------- 127

TABLES

PAGE

V-1 Effectiveness of Ground Cover on Erosion Loss at Construction Sites in Fairfax County, Virginia ---- 68

PREFACE

As we increase in numbers and affluence we need more highways, dams, powerplants, housing developments, and other energy consuming or producing activities. Each year the construction of these new facilities uses up more than 400, 000 hectares (about one million acres) of land, some of which had earlier served for the production of feed, food, and fiber crops; timber; water recharge, wildlife, recreation, and other continuing needs.

As we continue to alter the soil, water, and other natural resources to meet our needs, we often initiate abrupt changes in long established relationships between soils, plants, waterways, and people. Our ability to perform these changes is firmly established. The question is: How long can we continue to transform these resources in an uncontrolled manner at an ever increasing rate?

This report is concerned with one segment of the greater process of controlling the development of land and water resources, namely: processes, procedures, and methods to effectively control pollution resulting from construction activity - one of several nonpoint or area sources of water pollution. The audience addressed in this report includes those concerned with the tasks of government at all levels, the corporate community, labor, and interested citizens as a whole.

I. SUMMARY

This report presents information on processes, procedures, and methods for controlling sediment, stormwater, and pollutants other than sediment which result from construction activities. It is one of a series required under Section 304 (e) of Public Law 92-500, The "Federal Water Pollution Control Act Amendments of 1972."

Processes examined include site planning, preliminary site evaluation and design, use of planning tools, and structural and vegetative design considerations relative to development of a water pollution abatement plan suited to individual construction sites.

Procedures, at Federal, State, and local levels, relative to the control of land disturbing activities and the interrelations between various procedures and processes were also studied.

Methods examined include on-site erosion, sediment, and stormwater management control structures as well as soil stabilization practices useful for achieving control of sediment, stormwater runoff, and other pollutants resulting from construction activities. Stormwater management practices are discussed in detail.

Information presented in this report represents the state-of-the-art in the three areas. New processes, procedures, and methods for controlling sediment and other pollutants are continually being developed from time to time to make control more effective.

Information presented in this report indicates that water pollution resulting from sediment and other pollutants generated from construction activities can be prevented by the timely application of empirical structural and soil stabilization measures presently available.

Non-point source pollution control plans should be drawn up adhering basically to the following steps:

(1) Plan structures and vegetative measures that will protect environmentally vulnerable areas.

(2) Control the speed and volume of water runoff. Detain stormwater on the construction site. Use water diversion structures to divert water away from graded areas.

(3) Trap sediment on the site.

(4) Stabilize exposed soils by adhering to time limits set out in the schedules for site grading, seeding, and mulching. Use stage grading, seeding, and sodding.

(5) Determine the need for water pollution abatement measures on a site by site basis.

(6) Outline water pollution abatement procedures for inclusion in the construction contract. Prepare a water quality control plan that will minimize stream turbidity, changes in flow, and movement of fluids, oils, wastewater, fuels, aggregate wash water, mineral salts, and pesticides into waterways.

(7) Outline procedures for the maintenance and inspection of structural and vegetative controls for graded areas, borrow pit areas, dredge spoil areas, and soil stockpile areas, among others, on a periodic basis for inclusion in the construction contract.

II. CONCLUSIONS

Increasing numbers of people, coupled with increased family incomes and personal consumption patterns induce the accelerated development of new land and water resources, and the demand for new energy sources. All of these activities are construction oriented. On the premise that continued growth and construction are inevitable, at least for the next fifty years, it would appear the better part of wisdom for communities presently at the threshold of development to begin now the task of planning suitable stratagems for coping with nonpoint sources of construction-related pollution. The following conclusions have been made:

1. Planning for nonpoint source pollution control is but one facet of comprehensive planning for land and water management. An important goal of the control planning is the approval of architectural and engineering drawings and specifications that spell out pollution control practices permitting prospective contractors to bid and plan intelligently. Another is to give sufficient discussion to pollution control practices during the pre-construction conferences, to allow the timely installation of suitable structural and vegetative controls by the contractor.

2. Specific instructions as to structural and vegetative soil stabilization practices required on-site should be included in contracts. However, as the project develops, the need for additional control may become evident. When this occurs the contract should be amended. The need for water pollution abatement measures will be determined by the nature and properties of each site relative to its surroundings. Water quality control plans should be prepared that will minimize stream turbidity and changes in stream flow temperature. Pollution by fluids, oils, wastewater, aggregate wash water, pesticides, and other materials can be controlled by adequate erosion and sediment control measures.

3. Procedures for the maintenance and inspection of structural and vegetative controls for graded areas, borrow pit areas, sediment spoil areas, and soil stockpile areas should be included in a construction contract. Ordinarily, the installation of sediment control structures will be done before the start of grading, clearing, or other on-site land disturbances. Exposed soils adjacent to these structures should be stabilized soon after completion.

4. The effectiveness of various erosion and sediment controls in retaining sediment and other pollutants on individual construction sites has not been adequately studied. Further research is needed concerning the effectiveness of various controls in different parts of the country, so that cost trends and comparisons can be established. Pollution control training for construction managers, inspectors and other persons could go far in achieving better management practices for the abatement of water pollution.

5. For construction activities, no water-pollution abatement plan should be considered complete unless it includes plans for stormwater management.

The distinction between stormwater drainage and stormwater management often is poorly understood. Stormwater drainage involves either the direct release of stormwater into a channel or to an underwater collection system, with no concern for water quality. Stormwater management involves both the quantity and quality of runoff. It is accomplished by temporarily storing and regulating the release of runoff from small magnitude storms.

An areal or linear system of control, or a combination of both can be used. The system devised must be based upon the physical characteristics and the type and extent of proposed development of a watershed.

Basic evaluation and design techniques for stormwater management practices need improvement. Basic research presently underway in this field is judged inadequate to determine the most effective storm return frequency in the design of various stratagems.

6. The modern age of water quality legislation began in 1948 with the adoption of the Federal Water Pollution Control Act. Since that time, prevention-oriented sediment control procedures have evolved at State and local levels. Erosion, runoff, and sedimentation can be controlled on new construction sites through the requirement that an erosion and sediment control plan fitted to individual sites be approved before a grading permit can be issued. More effective coordination of construction plans and environmental plans is needed between Federal, State, and local governments. One necessary precondition for realizing this is the creation of opportunities for contact and dialogue within and between the several levels of government. Interagency cooperation during preliminary phases of project planning can lead to more substantial environmental benefits and economies.

The degree of coordination between agencies relative to sediment and pollution control on construction sites varies with the authority of each agency. This arrangement guarantees the lack of easy communication and the fragmentation of the decision-making process. Exceptions to the generalization suggest that when human initiatives are properly exercised between and within government institutions, there occurs a clearer understanding of agency responsibilities, much resolution of conflicts, an exchange of technical and scientific information and manpower, and a closer scheduling of related work programs. An integrated approach to erosion and sediment control can only be achieved when all Federal, State, and local organizations coordinate their efforts.

Local governments must have the legal authority to enter into intra- and inter-governmental agreements through memoranda of understanding, or delegated statewide powers, in order to take the initiative in generating workable sedimentation controls. Individual developers and contractors can support the costs of installation of necessary sediment and pollution control measures as a part of their normal construction activities.

7. Federal agencies engaged in all aspects of construction activity have the responsibility to inform contractors at the pre-bid

and pre-construction conferences as to the type and extent of on-site sediment control procedures. Responsibility for environmental standards on Federal construction contracts should be exercised jointly by the resident engineer or inspector and the contractor. Thus, the engineer should review workable site grading and drainage drawings and specifications for each construction site. The contractor, in turn, should install and maintain the required erosion control structures and practices.

8. Several states have developed or passed statewide laws to control and prevent pollution from sediment resulting from construction and other activities. According to these laws State soil and water conservation districts in conjunction with State and local regulatory groups concerned with water pollution abatement would have responsibility for approving controls. In its present form, the "Model State Act" does not cover stormwater management and pollutants other than sediment. Certain environmentalists have criticized this approach on the basis that administration of control is entrusted to local bodies subject to pressures from contractors and rural interests who could play down necessary control measures. New State legislation, however, that can bestow broader-based representation on soil and water conservation commissions will overcome some of these objections.

9. Since 1965 various municipal, county, and State statutes have been enacted requiring a permit for any land disturbing activity. By and large, these statutes require the State soil and water conservation districts to provide technical assistance and approval of sediment control plans for all new construction.

Since 1970, eight States have adopted variants of the National Environmental Protection Act (NEPA). California's version of NEPA requires county boards to make environmental assessments before issuing building permits to private groups concerned with land development. Thus, land development activities in the private sector can be directly affected.

10. Several agencies have responded to public opposition to new construction activities by using increased citizen participation

during the planning and design stages. For example, public as well as private agencies, associations, and conservation groups have set up information programs to develop and obtain broad support. There is a need for expanded use of continuing education, refresher courses, and in-house training programs. Guidelines and design manuals serve a useful purpose, but they should be reinforced by audiovisual programs seminars, field days and other efforts directed to the control of sediment and other pollutants.

III. INTRODUCTION

Some idea of the impact of increasing numbers of people on land and water resources in this country is seen in the decreasing per capita land acreage since 1940: from 7 hectares (17 1/3 acres) in 1940 to 4.5 hectares (11 acres) in 1971. Projected to the year 2000 the per capita acreage may go down to 2.7 hectares (6 2/3 acres).[1]

We know that even if the natural birthrate in the United States were to fall immediately to a rate lower than at any time in our history, population growth would not stop before the year 2020. Growing numbers of families, coupled with increased family income and personal consumption will lead to increased development of new land and water resources, and new demands for energy - all of which are construction oriented.[2]

Individual parcels of land owned by private citizens, corporate groups, and local governments account for two-thirds of the land mass in the U. S. The remaining one-third is administered by the Federal Government.

Privately owned land is the base from which comes much of our food, fiber, lumber, and other essential products. Locally controlled lands also must provide the space needed for constructing new recreational areas, dams, powerplants, highways, housing developments, and commercial and industrial facilities. Thus in theory at least, the demands of new construction are competitive with land and water resources needed to produce food.

Local governments are properly responsible for most land and water resource decisions. At times, however, our political institutions appear to suffer from an inability to recognize that certain laws and procedures have been outflanked by technological advances, or for other reasons.[2] Other evidence suggests that legislators as well as the voters are often reluctant to grant administrative powers to environmentally oriented agencies.[2]

In 1971, the President proposed legislation encouraging the States, coordinating with local governments, to assume land use (and presumably watershed) planning and regulatory authority over transportation, water resources, energy, and other areas of environmental concern.[3] This proposal springs from the idea that few States or local communities have assumed the regulatory powers needed to control broad land and watershed problems. Oftentimes local communities may use zoning and other regulations to block private developments beneficial to their future growth. Dependence on immediate tax revenues often makes it impossible for local communities to channel new construction activities in a controlled manner.[2] Rapidly urbanizing communities frequently use grading ordinances as one means of controlling the rate of land disturbance and other construction activity.

In States already feeling heavy land and water resource development pressures (Florida and California) citizen demands are being heard for an immediate halt to future construction and growth. On the other hand, continued growth appears inevitable.[4] Support for this view can be seen from past experience (in 1963) of citizens, land owners, planners, and developers in the Green Spring and Worthington Valleys (The Valleys) of Baltimore County, Maryland.[5] Planners estimated the monetary advantage of controlled over uncontrolled growth to be in excess of 7 million dollars during a twenty year period. Court tests of this concept were upheld in favor of controlled growth.[5]

One of the key elements in the Valleys concept was that new construction activities (highways, housing, and industrial centers) were directed maximally to the open plateau (of the Piedmont) where the soil subsurface properties and water resources were determined to be amenable to high intensity use. Under these conditions, relatively simple and inexpensive engineering structures and vegetative practices could be used to keep sediment, stormwater runoff, and other pollutants out of important waterways and groundwater recharge areas.

The intended thrust of this report is that water pollution resulting from sediment and other pollutants (including stormwater) generated from all types of construction activity can be minimized by the timely application of structural and soil stabilization measures (Fig. III-1 thru III-4). Emphasis is placed on the key word "timely". This adjective is defined as that which happens at a suitable time. In relation to non-point source pollution control, this word implies the exercise of individual or institutional planning initiatives that culminate in a plan for water pollution abatement before construction actually begins. In the context of this report, "timely" has maximum relevance in terms of the processes (preliminary site evaluation, preliminary site development planning, preliminary design, final design, etc.) relative to the procedures (statutory laws, ordinances, land use regulations, health orders, zoning rules, memoranda of understanding, etc.) specified by Federal, State and local institutions. Beyond the appropriate processes and procedures are the on-site methods and systems (contract specifications, design standards, and construction practices) for achieving control of sediment, stormwater runoff, and other pollutants during construction.

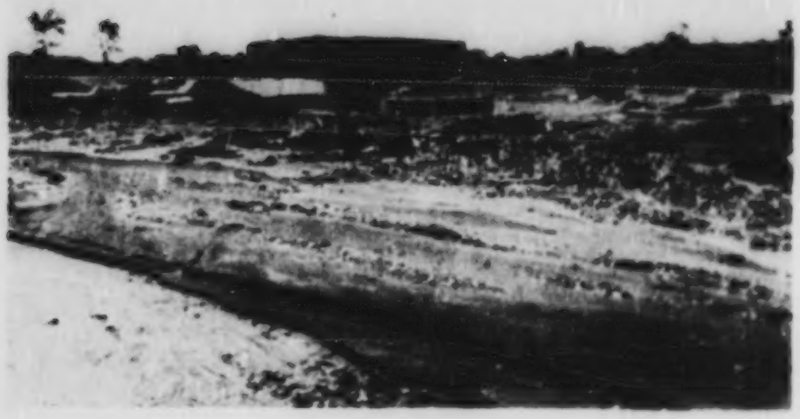

FIGURE III-1 Construction site lacking structural and vegetative soil stabilization measures for controlling erosion, runoff, and sedimentation

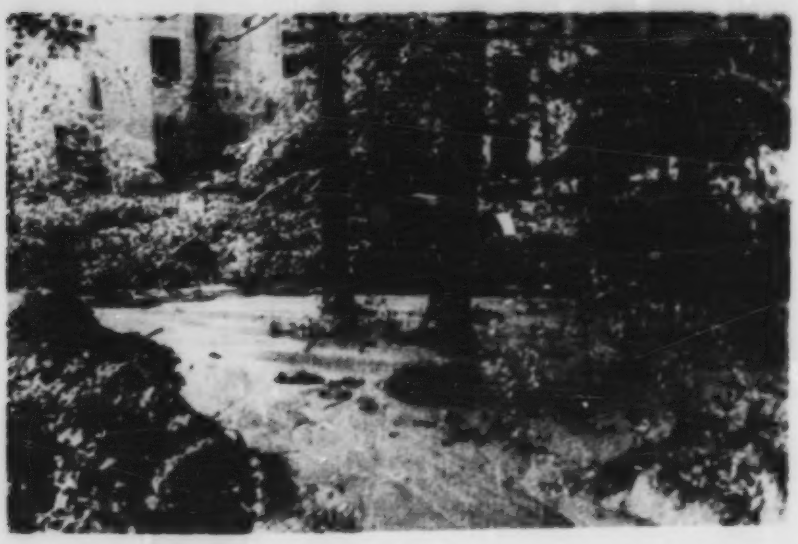

FIGURE III-2 Sediment deposited in a wooded area threatening the survival of specimen trees

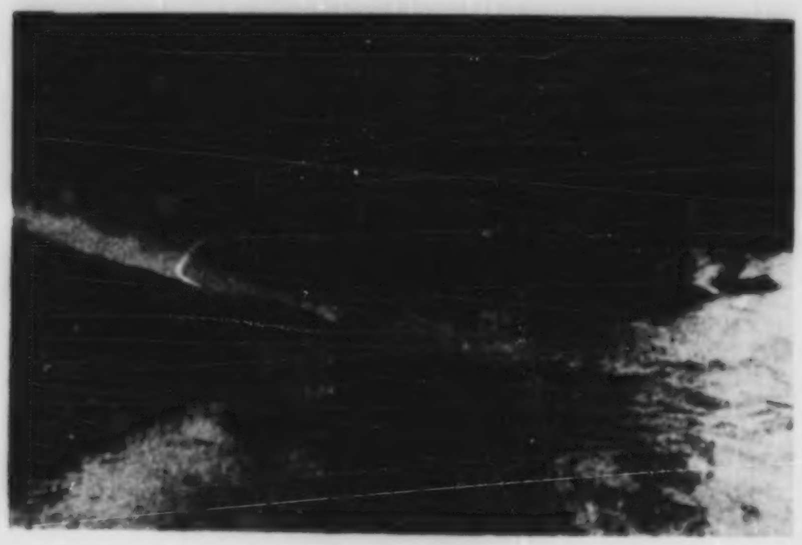

FIGURE III-3 Turbidity plume entering a waterway as stormwater runoff from a construction site

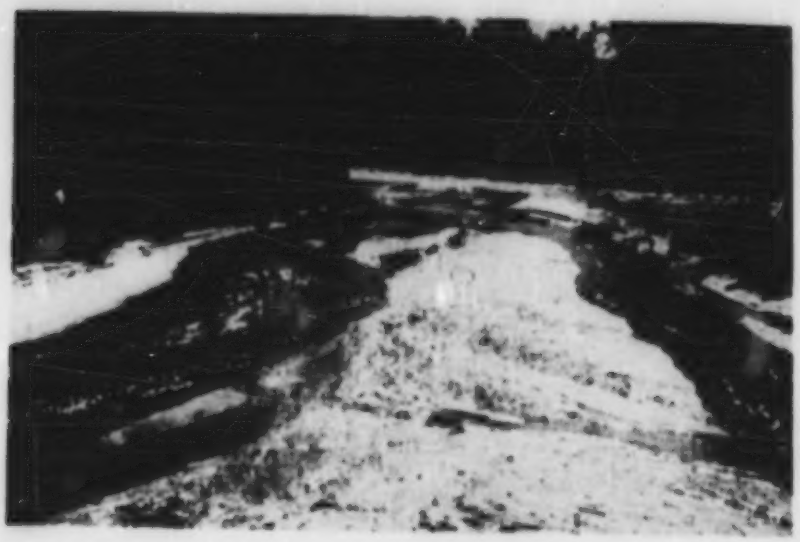

FIGURE III-4 Sediment deposited along a waterway downstream from highway fill

Processes for drawing up water pollution abatement plans specific for individual construction sites are discussed in Section IV. Procedures for achieving compliance with applicable laws, along with certain historical relationships and case studies are discussed in Section IX. Methods of achieving control of erosion, sedimentation, stormwater runoff, and other causes and forms of pollution are discussed in Sections V through VIII.

The reader is advised that the information presented herein has developed slowly along empirical lines during a period of more than fifty years. We have reported selectively on a state-of-the-art basis, touching all bases.

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IV. SITE PLANNING

OVERVIEW

Areas now experiencing accelerated growth as a result of rapid increases in population, business, and industry, or those anticipating this experience at some future time, share a common need of comprehensive planning for the orderly development of water pollution abatement programs. But the evidence at hand suggests that there is limited provision within the present organizational framework of government or corporate planning groups to attain comprehensive planning.[1] Rather, planning generally occurs within three major compartments: land use planning involved largely with subdivision (Fig. IV-1) and open space development; transportation planning concerned with the construction of highways and rapid transit, (Fig. IV- 2, 3), and facilities planning (private and public) concerned with power plants (Fig. IV-4), powerlines, buildings, dams, reservoirs, wastewater disposal, and sewer systems, among others.

FIGURE IV-1 Aerial view typical of many suburban housing developments. (Courtesy of the U. S. Dept. of Agric.)

FIGURE IV-2 Aerial view typical of urban transportation networks. (Courtesy of the U. S. Dept. of Agric.)

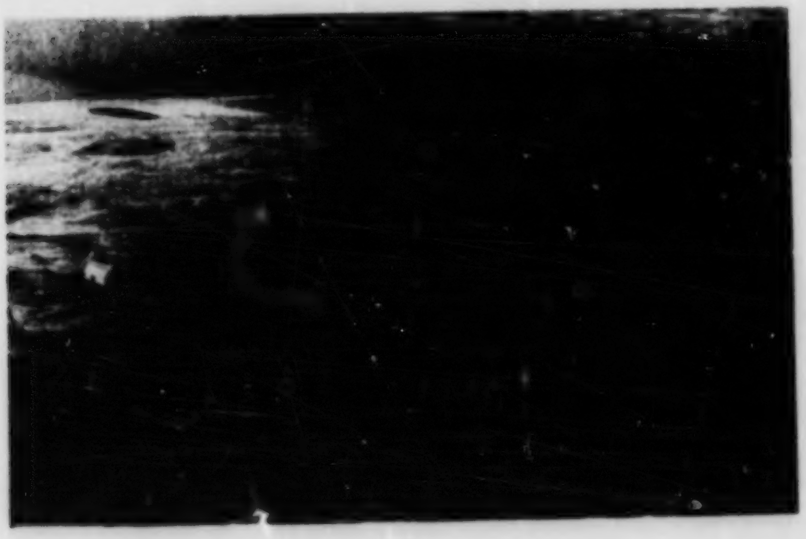

FIGURE IV-3, Aerial view typical of suburban land-clearing for highways and other facilities. (Courtesy of the U. S. Dept. of Agric.)

DANGER
HARD HAT
AREA

FIGURE IV-4 Excavation and construction for a large-scale electric power plant

Innovative strategies for promoting the lateral flow of information from one group to another could avoid the difficulties in which planning done by one discipline on the basis of hidden assumptions, can be challenged by another planning discipline based on entirely different assumptions.[1] An integrated approach is badly needed with respect to land use, zoning, and drainage and flood control policies.[2] Apparently, State and regional planning groups have yet to find a viable political base permitting establishment of rational siting and land use guidelines.[3]

In spite of these and other problems, significant progress is often made by highly motivated citizen groups in areas where close working relationships can be established with State and local governments. An interesting case study illustrating this point is provided by the success of concerned citizens in the Green Spring and Worthington Valleys (the Valleys) of Baltimore County, Maryland. Concerned citizens, in collaboration with private and public planning groups, drew up development plans acceptable to the county and State governments which accomplished the following: [4]

(1) accommodated accelerated development in the Valleys

(2) prohibited sewerage installation on the valley floor, thereby directing highway and housing developments up to the plateau areas

(3) subjected woodland and forests having trees above 10 centimeters (4 inches) caliper to preservation regulations

(4) insisted that development should respond to the operation of natural processes (or physiographic determinants) intrinsic in the landscape

(5) recognized concepts already recommended by regional planners

Planners recognized that natural features and processes such as topography and subsurface geology, surface and groundwaters, floodplains, soil erosion, and the distribution of forests and woodlands have implications for development, in that they control the capacity of each area for development. [4] These same factors also relate to the susceptibility of each area to erosion and sedimentation damage. [5]

The purpose of this chapter is to discuss the general principles of site planning and design relative to the water pollution management plans for construction and development activities. Emphasis is placed on the fact that planning for sediment and pollution control is but one facet of planning for overall land and water management. Nevertheless, essentially the same information base will be required. [5]

GENERAL PRINCIPLES OF PLANNING AND DESIGN

Effective sediment and pollution control begins with the preliminary evaluation of the suitability of a given site for the kind of land disturbance or construction to be done, based on the inventory of the prime physical features of that site.[4-6] This principle holds whether one intends to build a highway, powerplant, dam, (Fig. IV-5, 6), shopping center, ski slope, or a high-rise building. Aside from consideration of the prime physical features, aesthetic, social, economic, and political factors also contribute to the process of planning for water pollution management. For example, construction of major highways, flood control projects, transmission lines, etc. can affect the economy, the way of life, and the visual experience of all people within its sphere of influence.[4] These and other factors are usually weighed against projections relative to the pollution potential of a given construction site.[4,5]

FIGURE IV-5 Embankment for dam construction

FIGURE IV-6 Excavation area relative to dam construction

One important goal of sediment and pollution control planning and design should be the creation of a set of architectural and engineering drawings and specifications that spell out pollution control practices, so as to permit prospective contractors to bid and plan intelligently. Similarly, sufficient discussion should be given to pollution control practices prior to and during the pre-construction conference to permit the timely and orderly installation of suitable structural and vegetative controls.[7]

An example illustrating some of these points is seen in the experiences and encounters relative to problems of water turbidity control during construction in 1972 of the Teton Dam and power plant in Idaho.[8] Contract specifications directed the contractor to comply with applicable Federal and State laws, and regulations concerning water pollution control. Even though the contractor built a 12 x 49 meter (40 x 160 foot) settling basin at the downstream end of the dam, a turbidity problem still existed. The settling basin was used because the water clarifier originally planned for the project could not be put into operation until ten months after the beginning of construction.

Turbidity control became erratic after the first month of operation of the settling pond, creating problems for the disposal of turbid water from the damsite, tunnel excavation, batch plant, channel change areas, and the downstream service yard area. Under these conditions, compliance with water quality specifications was in doubt. After several visits were made to the site by Federal, State, and citizen's environmental groups, the contractor suggested that additional settling ponds should be used for controlling large volumes of on-site turbid waters.

Systematic analyses of the overall problem made by the developer, in cooperation with the contractor, revealed that the original contract specifications were unclear as to the several sources of turbidity. Also unclear was the corresponding technique for controlling each turbidity source. For example, the quality and quantity of water coming from the foundation dewatering area, borrow areas, tunnels, and batch plants required different types of treatment than that from other areas. The suggestion was made by the contractor that settling ponds were superior to the water clarifier specified in the contract for controlling large volumes of water coming from the foundation dewatering, and borrow areas. Use of the dual system also increased costs both to the contractor and the developer.

Later on the recommendation was made by the developer (the Interior Department's Bureau of Reclamation) that future contract specifications should give the contractor the responsibility of planning and implementing turbidity control based on the natural or background turbidity of the waterway, in accordance with applicable Federal and State regulations. [8]

This experience contains several elements supporting the basic objectives of effective planning for water pollution abatement on heavy, and other construction sites:

(1) cooperation and dialogue between the developer and the contractor at all times

(2) planning for prevention of water pollution shared equally at all levels

(3) flexibility in the application of pollution control measures at all levels

(4) following through on regulatory and citizen efforts to protect vital land and water resources

(5) maintaining high water quality for use by plants, fish, mammals, and man

During the preliminary site evaluation, sufficient information should be collected to provide sensible solutions to potential erosion and sediment control problems.[5-9] For example, the kinds of on-site protective measures needed during most construction activities will be determined, in part, by the following:

(1) erodibility potential of the exposed soils

(2) type and location of the construction activity

(3) extent of exposed soils

(4) time period of exposure of readily erodible soils

(5) expected frequency and intensity of rain and windstorms

(6) length, steepness, and surface roughness of exposed soil slopes

(7) resistance of the soil to compaction, and the stability of soil aggregates

(8) water infiltration capacity of the soil profile

(9) chemical, physical and biological nature of subsurface soils

(10) size and density of woodlands, copses, and forests contiguous to construction site

(11) extent of dust and fire hazards

(12) extent of impervious surface constructed

Successful plans should include close scheduling and coordination of construction activities, and provide for the maintenance of conservation practices. Every effort should be made, also, to minimize damage to stream channels and other drainageways by use of suitable stormwater detention structures. Early in the planning for construction, controls or limitations that may be imposed by local, State, and Federal agencies should be investigated. For example, securing licenses, permits, easements, and other matters allow necessary modifications to be made in designs and specifications before the project is advertised for bids. Contacts should also be established early with various agencies having jurisdiction over water resources, water quality standards, and other environmental matters.

During the pre-design and design stages, certain problems to be taken into account relative to water quality include:[5-10]

(1) disturbance of groundwater tables

(2) construction on or near potential landslide or mudslide areas

(3) installation of stream crossing structures where stream fordings are needed (Fig. IV- 7)

(4) encroachments on stream flow by land fills, culverts, dikes, and buildings

(5) influences on stormwater runoff imposed by an increase in the surface area of impervious streets, parking lots, and buildings

(6) changes in drainage areas caused by diversions and gradings

(7) development of borrow pit areas

(8) disposal of sediment spoil and other solid wastes (Fig. IV-8)

(9) flood plain excavation work

(10) stream channel improvements

(11) disposal of petroleum wastes, pesticides, and other chemicals

(12) control of dust, smoke, and fire

(13) construction of access and haul roads

(14) nearness of the construction site to streams, lakes, and other vulnerable water bodies

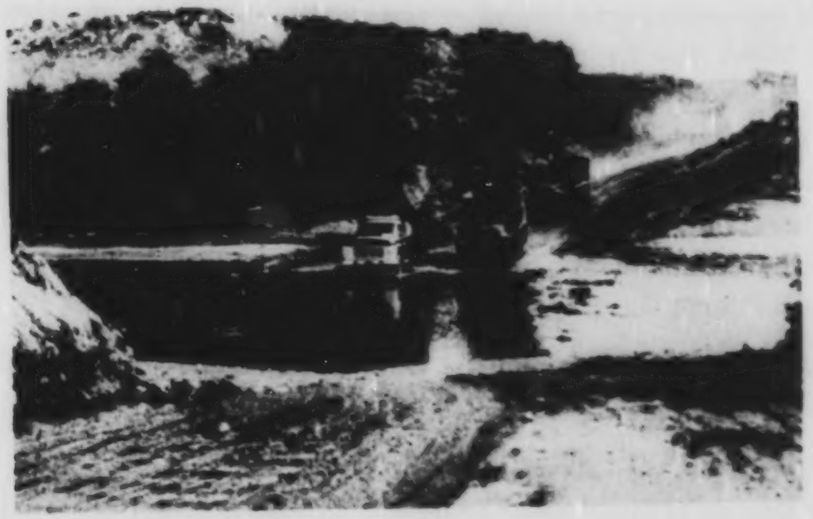

FIGURE IV-7 Stream fording or crossing areas need protection

FIGURE IV–8 Dredging operations and spoil disposal

In heavy construction work such as occurs at damsites, additional precautions must be used to keep sediment and other pollutants out of the waterway.[10] For example, the principal spillway barrel should be built to a size, shape, and grade that will minimize sedimentation. All areas, particularly those disturbed by stream diversions needed during construction, should be temporarily stabilized with mulch, vegetation or chemicals. Other considerations during dam construction activities include:[10]

(1) Construct debris basins downstream from the embankment to catch sediment from embankment and adjacent borrow areas.

(2) Build sediment traps in the channel downstream from the damsite. Dispose of sediment prior to removal of the trap.

(3) Locate spoil areas downstream from the embankment, thereby directing runoff toward stabilized parts of the floodplain.

HYDROLOGIC AND HYDRAULIC CONSIDERATIONS

The range of storm frequencies most often used in the design of storm drainage structures is 2 to 15 years for storm sewers in residential areas, and 10 to 50 years in commercial and high value districts. For flood control work the 50 to 100 year storm frequency is used.

Ditches, channels, and drainageways must accommodate the maximum design flow and the allowable average velocity in the ditch section. The most common channel cross section for a vegetated waterway is the parabolic form ordinarily found under natural conditions. Since channel erosion is a function of velocity, depth, and time; and urban runoff peaks are short-lived, channel depth and flow velocity are key design parameters. From a practical standpoint, choices of channel design can be based upon hydraulic, structural, environmental, and sociological considerations. Early in the planning stage, decisions must be made as to whether the channel will have to be paved to accommodate the highest flow velocities, or grass-lined for intermediate velocities. If the latter choice is made, care must be used in choosing plants that can survive disruption by sediment deposition and scouring action. Grasses used for channel linings should have a low, dense growth habit. Other hydraulic considerations refer to channel efficiency, grade, side slope angle, bottom width, and alignment.

VEGETATIVE CONSIDERATIONS

Vegetative soil stabilization practices such as direct seeding, sodding, plugging, and sprigging should be thought of as being an integral part of, and equal in rank to mechanical structures for the control of erosion and sedimentation. During the design stage, close working relationships should be established between the architect, engineer, and the plant and soils specialists. Prior to beginning grading operations, plans should be made to preserve as much of the natural plant cover existing on-site as possible, regardless of its estimated dollar value. These areas can be used with telling effect as filter strips or buffers to supplement various structures for controlling erosion and sedimentation during construction (See Section V).

Specific instructions as to the need for immediate vegetative stabilization of exposed soils should be included in the construction contract. Disturbed areas requiring immediate vegetative stabilization are: drainageways, cut and fill slopes, borrow pit areas, excavations, and soil stockpiles. Greater use should be made of quick-growing annual grasses on these critical areas for temporary protection during grading or permanent seeding delays.

Except on soils having gentle slopes and the highest native fertility, defined as non-critical areas, it is very difficult to establish superior permanent or long-lived perennial grasses and legumes in a one-step process. Two or three-step fertilizing and seeding practices over a period of several years are preferred over a one-step approach along highway cut slopes and other critical areas.[11]

Serious plant growth problems may arise on long, steep cut slopes because of the danger of soil slippage, deficiencies in plant nutrients, or unpredictable fluctuations in available soil moisture at different levels on the slope faces. This problem can be minimized by using diversion structures such as terraces (Fig. IV-9), and by surface roughenings (See Section V).

FIGURE IV-9 Terracing across steep slopes along highways to reduce runoff, prevent soil slippage, and aid plant growth

During periods of extreme drought, cold, or other unfavorable planting conditions, one can spread a protective layer of straw or hay mulch over the exposed subsoils and overseed later on when more favorable growth conditions develop. The choice between annual, and/or perennial species should be left to soil and plant specialists familiar with local growing conditions. In some situations, quick-growing annual grasses can be established and allowed to grow nearly to maturity (August or September) whereupon they can be sprayed with a contact herbicide. After three or four days, the dead plant material provides mulch that can be overseeded with superior perennial plant materials.

Grasses and legumes are considered superior to trees, shrubs, and ground covers for initial soil stabilization because their fibrous root systems (grasses in particular) characteristically bind soil particles, encourage the formation of water stable soil aggregates, and protect the soil surface from erosion by water and wind.

USE OF PLANNING TOOLS

Some of the most indispensable tools of site planning in relation to erosion and sediment control are topographic and other maps used to delineate major soil types, waterways, woodlands, and other vulnerable areas determinate to sediment and pollution control on a given construction site. Areas of the site requiring special protection of aesthetic or historical areas can also be shown. Base maps having a scale of about 610 meters to each 2.54 centimeters (2000 feet to the inch) and contour intervals of about 6 meters (20 feet) are useful on large-sized tracts for general planning.

Enlarged aerial photographs or stereoscopic pairs of air-photos giving a three-dimensional perspective (viewable at the soil conservation district offices) are useful for showing vulnerable areas such as wetlands, sand dunes, and waterways in a highly visible form. Large-scale maps are required to chart major soil type boundaries, drainage systems, rock outcrops, buildings, roads, and archaeological sites.[5]

Base maps having scales ranging from about 15 meters to each 2.54 centimeters (50 feet to the inch) and contour intervals of 0.61 meters (2 feet to the inch), up to about 76 meters to each 2.54 centimeters (250 feet to the inch) and contour intervals of about 1.5 meters (5 feet to the inch) are useful for locating discrete erosion and sediment control practices on the average to small-sized site.[5]

The on-site evaluation of the potential construction site should be performed by persons knowledgeable in various disciplines such as agronomists, biologists, engineers, geologists, hydrologists, landscape architects, site planners, and soil scientists.

Information acquired from this evaluation can be used in the design stages to fit the best sediment and pollution control practices to a specific site. Topographic mapping should be extended a minimum of 30 meters (approx. 100 feet) beyond site development boundaries in order to assess the effect of erosion and sediment deposition on adjacent properties.[5]

Effective erosion and sediment control plans are built upon numerous sources of information relative to the construction site.[12] Offices in each of the county soil and water conservation districts are valuable sources of information, such as: soil survey reports, soil erodibility, drainage systems, topography, agricultural value of soils, and land use characteristics. Soil survey reports furnished by the Soil Conservation Service (SCS) provide information on the suitability of various soils for locating pipelines, roadways, water impoundments, and drainage systems.

The soil survey information does not eliminate the need for detailed on-site studies relative to such water-related phenomena as landslides, mudflows, and downhill creep.[13] Also, limitations of scale on detailed soil maps make it necessary to conduct detailed on-site studies of drainage patterns, surface water, geology, woodlands, and wetlands.[14] Beyond this, soil survey information can be used to rate each kind of soil in terms of its inherent suitability for specific land uses and engineering applications.[15]

Information on the location of critical mineral deposits, aquifers, groundwater recharge areas, and rock outcrops can be obtained from the U. S. Geological Survey offices.

The principal source of water runoff data is the "Water Supply Papers" of the U. S. Geological Survey. These papers contain records of daily flow, mean flow, yearly flow volume, and extremes of flow. The magnitude of runoff is most commonly estimated by the so-called rational method. This technique is most useful for designing hydraulic structures for construction areas under 81 hectares (200 acres) in size.[16-19]

Highway offices at the county or State levels can furnish information on soil engineering properties, and areas having stormwater drainage or flooding problems. These sources can also furnish information [redacted]tion of present and proposed roads and superhighways.[5]

Essential information on local zoning ordinances, subdivision regulations, grading ordinances, and septic tank regulations can be obtained from county zoning and planning offices.

Regulations pertaining to the use and disposal of pesticides, and other chemicals on construction sites can be obtained from the environmentally oriented county and State offices.

Most planning and design techniques do not consider soil erodibility as a basis for recommendations on the design of cut and fill slopes. An important tool for this purpose, and for planning and evaluating erosion and sediment control practices, has been developed by workers of the Agricultural Research Service of the U. S. Department of Agriculture.[20] This empirical technique, the Universal Soil Loss Equation, combines such factors as rainfall, soil erodibility, slope length, slope gradient, cropping management (extent of vegetative cover) and erosion control practices to arrive at an average annual soil loss from sheet and rill erosion. Adjustment factors can be developed for determining soil losses for time increments of less than one year.[21]

Recent research developments have made the Universal Soil Loss Equation a better tool for use on construction sites. Contributions in this area include the development of a soil erodibility nomograph [22] (See Appendix A), a topographic factor (combined length of slope and steepness of slope factors) nomograph, [23] and further research on vegetative and erosion control practice factors. [21]

If an allowable soil loss is provided, the equation can be used to determine allowable slope length and steepness. The equation does not, however, account for deep-seated stability problems such as landslides. Additional on-site studies and design procedures are needed to evaluate these problems. Furthermore, the soil loss equation does not quantify the amount of sediment that becomes a water pollutant. Some sediment will be deposited at the base of the slope and become stabilized by vegetation in due course. To compensate for the amount of sediment that does not reach the waterway, various procedures are being used. [21,23,24]

WATER POLLUTION ABATEMENT PLAN

Planners and developers should give prime consideration during the preparation of preliminary site development plans to the following factors: [5,25-29]

(1) Assess soil limitations and suitability of the site based on soil survey, geological, and other sources of information.

(2) Identify problem soils, collect soil samples from drilling operations and classify them as to: erosion potential; water infiltration capacity; moisture retention capacity; soil pH; available nutrients; texture; structure, and certain engineering properties.

(3) Identify woodlands, wetlands, waterways, and other vulnerable areas on the site. Prepare a site map showing trees, and special areas to be protected from equipment traffic. Preserve

established vegetation to the maximum extent.

(4) Examine the existing and proposed drainage patterns. Show on-site and off-site drainage conditions.

(5) Examine lengths and grades of existing long slopes. Use existing topography and vegetative cover to supplement plans for control of erosion, sediment, and runoff.

(6) Assess the amount of site grading needed for development. Indicate existing and proposed topographic lines on the site map. Extend topography information at least 30 meters (approx. 100 feet) beyond property lines. Show improvements, property lines, and limits of grading on the site map. Use different grades for different slope heights. Provide a cut and fill balance sheet by indicating method and location for disposal of excess material and source of all fill material. Prepare an erosion and sediment control plan for the entire construction area and the soil stockpile and borrow areas. Prepare a site grading schedule. Obtain property easements, if needed.

(7) Evaluate watershed problems, upstream and downstream from the construction site. Take photographs of critical areas along downstream segments of waterways. [27]

Armed with information set forth in items 1 through 7, the planner should proceed to draw up the water pollution abatement plan adhering basically to the following steps:

(1) Plan structural and vegetative measures that will protect environmentally vulnerable areas.

(2) Control the speed and volume of water runoff. Detain stormwater on the construction site. Use water diversion structures to divert water away from graded areas.

(3) Trap sediment on the site.

(4) Stabilize exposed soils by adhering to time limits set out in the schedules for site grading, seeding, and mulching. Use stage grading, seeding, and sodding (Fig. IV-10, 11).

(5) Determine the need for water pollution abatement measures on a site by site basis.

FIGURE IV-10 Use of staging or phasing of vegetative soil stabilization practices along highway cut slopes

FIGURE IV-11 Use of staging or phasing of vegetative soil stabilization practices along an access road

(6) Outline water pollution abatement procedures for inclusion in the construction contract. Prepare a water quality control plan that will minimize stream turbidity, changes in flow, and movements of fluids, oils, wastewater, fuels, aggregate wash water, mineral salts, and pesticides into waterways.[28]

(7) Outline procedures for the maintenance and inspection of structural and vegetative controls for graded areas, borrow pit areas, sediment spoil areas, and soil stockpile areas, among others, on a periodic basis for inclusion in the construction contract.

The best water pollution abatement plan is the one that minimizes or prevents erosion, sediment,and runoff damages. Other pollutants should also be kept out of waterways. The speed and volume of water runoff can be controlled more easily by designing for short slope lengths, following the natural ground contour to avoid high cuts and fills, and by blending slope grades into the natural landscape. Keep in mind that vegetative practices are an integral part of structural practices.

Dust produced by cement handling, rock and aggregate crushing, truck and materials movement on unpaved haulroads, sandblasting, and other operations can be a health hazard to construction workers and people residing near the construction site. Contractors should not only comply with Federal, State, and local ordinances relative to dust and noise generated on construction sites, but also motivate their employees to use dust protective gear and dust control methods that will minimize damages to people, vegetation, and waterways.

Sediment traps may be either temporary or permanent structures, depending on the dictates of the specific site. Sediment traps have to be cleaned from time to time and it must be so indicated on the plans. Typical drawings of all sediment control structures must be furnished to the approving office. Pertinent information from design computations for all basins, waterways, and channels should be shown on the plans. Ordinarily, the installation of sediment control structures, and the stabilization of exposed soils adjacent to these structures, will be done before the start of any grading, clearing, or other disturbance of the existing surface of the site.

Examples of guidelines for engineers and planners to use in designing, installing, and maintaining various control structures and vegetative practices are provided in the report "Standards and Specifications for Erosion and Sediment Control in Urbanizing Areas," [31] as well as in other documents. In some cases, the engineer may find it necessary to use more stringent designs for certain site conditions than would be indicated by the guideline. For example, with reference to a structure such as an interceptor dike, the guidelines state that "interceptor dikes must have an outlet that functions with a minimum of erosion." This is an obvious reflection on the known variability in the erosion potential of soils from site to site.

Special information relative to on-site and off-site problem soils, protected areas, calculations, and off-site plans are usually given on the plan in a section entitled "Special Notes." If, in the opinion of the planner, some parts of the construction site contain problem soils, instructions detailing methods for dealing with these will be shown under "Special Notes." Problem soils include those having poor internal drainage, low resistance to water and wind erosion, tendency to mudslide and downhill creep, and droughtiness.

Protected areas refer to woodlands, specimen trees, wetlands, grasslands, and waterways. Areas not to be disturbed during construction should be declared off-limits. Significant tree specimens must be marked on-site and also on the development plans.

Calculations refer to such matters as the sediment trap schedule, storm drainage schedule, grading schedule or balance sheet on cuts and fills, and the volume of off-site fill sources. These should be included with the water pollution abatement plan. Assistance with these calculations can be provided by the local officer designated to approve the water pollution abatement plan. The overall content of the "Special Notes" will be dictated by the nature and properties of the individual construction site, and by local orders, regulations, and ordinances. Several examples of these notations referring to timing of soil stabilization measures, and certain other construction practices are set forth in Appendix B.[27,30]

When the planner is satisfied that he has a plan that will gain the approval of the official approving officer, he submits it to the approving office. Examples of the approval statement, and certifications required by the planner and the developer are shown in Appendix C.[30]

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V. EROSION CONTROL

OVERVIEW

In a classical sense erosion is defined as the process by which the land surface is worn away by the action of water, wind, ice, or gravity. One of the natural processes by which the topographic features of the land are formed is referred to as natural or geologic erosion. Except for some cases of shore and stream channel erosion, natural erosion is a very slow process. In that it has occurred at a slow and relatively uniform rate over thousands of years, natural erosion does not, to any large extent create an environmental problem. In fact, the sediment derived from such erosion is an essential ingredient in the balance of the environment.

Water-generated sediment can become a serious problem when natural vegetation is destroyed by man's activities. These activities include exposing the soil surface, altering drainage patterns, and covering permeable soil surfaces with impermeable structures. All of these factors greatly accelerate the overall rate of erosion. When this occurs, the erosion is commonly referred to as "accelerated" erosion. Such erosion is reported to produce approximately 70 percent of all sediment generated in this country. Accelerated erosion must be controlled in order to minimize damage to water resources as well as land resources.

The three major causes of accelerated erosion are water, wind, and gravity. Water generated erosion, or water erosion as it is normally referred to, is by far the most severe form of erosion from a water pollution standpoint, in that soil detached by water is concentrated in waterways.

Wind erosion is a secondary contributor to water pollution. The wind eroded particles deposited in their new location may be more susceptible to water erosion in a later rain storm.

Wind is the major cause of pollution in an arid area where rainfall is scarce and little vegetation exists. However, in those areas of the country having abundant rainfall and especially in well developed urban areas, water, both as rainfall and runoff, is the major culprit. This section will deal largely with the control of water erosion. Keep in mind, though, that vegetative or chemical soil stabilization practices used in reducing water erosion work equally well in reducing wind erosion.

Gravity related erosion is reflected by landslides and soil slippage. These are generally mass movements of soil resulting from the construction of excessively steep or otherwise unstable slopes. This form of erosion can be a serious source of sediment pollution along waterways where slippage or sloughage results in the direct introduction of soil into the waterway. Massive earth moving activities along waterways, such as, dam construction and major highway construction are most susceptible to pollution from gravity erosion.

Accelerated water erosion can be divided into three major categories: overland erosion, stream channel erosion, and shore erosion.

(1) Overland Erosion - Overland erosion occurs on denuded slopes above natural drainageways as a result of rain splash and runoff. This category is the largest source of sediment during construction operations and includes such types of erosion as sheet, rill, and gully. Sheet erosion is the removal of a fairly uniform layer of soil from the land surface as a result of rainsplash and runoff. Rainsplash is the impact of the raindrop on a bare soil surface. The force of impact breaks larger soil aggregates down into finer particles which are more vulnerable to removal by ensuing runoff. Additional damage is done when these finer particles settle into soil pores to cause a decrease in the rate that water penetrates into the soil. As a result of this "surface sealing", runoff increases and additional soil is detached and transported

downslope. The runoff associated with sheet erosion is referred to as "sheet flow", which is runoff spread rather uniformly over the slope. When sheet flow is heavy, water concentrates in low areas to form rivulets which cause rill erosion. Such erosion is evidenced by the development of small grooves spaced fairly evenly along the slope. Individual rills range in depth and width up to several cms. (in.) and when considered over the entire area reflect a considerable soil loss (Fig. V -1). If left uncontrolled, erosion will increase in in the rivulets to a point where they form gullies. Gully erosion is a major problem in any unprotected area subjected to a concentrated flow of water (Fig. V-2).

(2) Stream Channel Erosion - Accelerated stream channel erosion occurs in intermittent or permanent storm channels as a result of such factors as increased runoff from developing areas, the removal of natural vegetation from stream banks, and channel alteration on construction projects. Stream channel erosion causes the greatest damage in urbanizing areas where a large increase in runoff, coupled with construction encroachment onto floodplains, results in massive channel degradation and increased capability to transport sediment downstream (Fig. V-3).

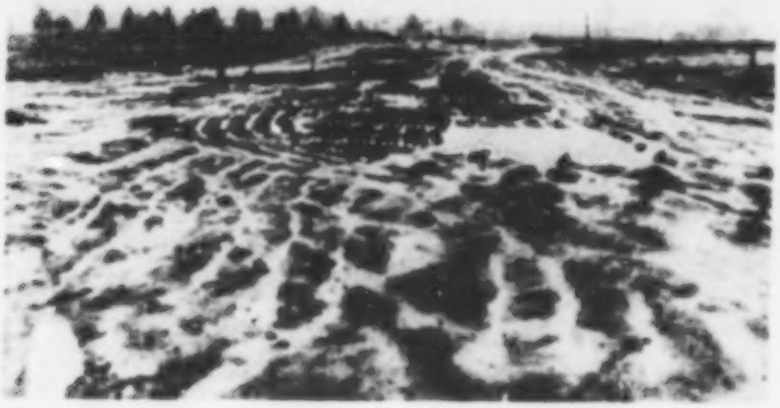

FIGURE V-1 Water concentrating in rivulets

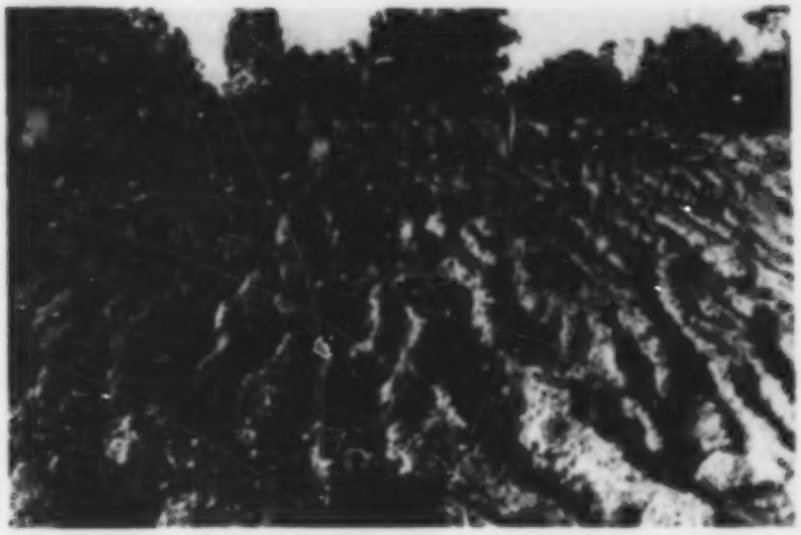

FIGURE V-2 Gullies formed in unstabilized slope

FIGURE V-3 Stream channel erosion

(3) Shore Erosion - Shore erosion occurs along large bodies of water due to the impact of waves against a shoreline and the resulting backwash. On major bodies of water, littoral currents or long shore currents, also play a part. This type of erosion is accelerated by such activities as the destruction of natural vegetation along the shoreline, construction encroachment onto the shoreline, and the generation of waves as a result of boating activity.

The severity of erosion is influenced by four major physical factors: climate, vegetative cover, soil, and length and steepness of slope.

(1) Climate - The climatic parameters affecting erosion include the amount, intensity, and frequency of rainfall and the temperature.

Although erosion is normally more severe on bare soils in areas having abundant rainfall than in areas having little rainfall, intensity and frequency of rainfall must be considered when comparing areas of similar precipitation. Both of these rainfall factors influence the amount of runoff that occurs. Runoff occurs when the intensity of rainfall exceeds the infiltration rate of the soil and the surface or depression storage. Frequency of rainfall influences the moisture content of the soil, which in turn has a major influence on the infiltration rate. The higher the moisture content, the lower the infiltration rate and the greater the potential for runoff.

In temperate regions of the country subject to prolonged ground freeze and considerable snowfall, temperature has a major influence on erosion. A frozen soil is highly resistant to erosion. However, rapid thawing brought on by warm spring rains can lead to serious erosion. Temperature is also directly related to the amount of organic matter which collects on the ground surface. The cooler, less humid climate in the northern portion of the country is more conducive to the build up of organic matter in the surface soil than in the hotter climates of the Southern portions of the United States.

(2) Vegetation - Vegetation is one of the more important factors influencing soil erosion. In most instances, vegetation is the most desirable material for controlling soil erosion. It performs a number of important functions including: shielding the soil from the impact of the raindrops, retarding surface flow of water thereby permitting greater infiltration, maintaining a pervious soil surface capable of absorbing water and removing subsurface water between storm events by transpiration. On a graded slope, the condition of the installed vegetation will determine its effectiveness in reducing erosion. A cover of vegetation which is not properly established or maintained will not be fully effective in controlling erosion.

(3) Soil - The types of soil at a site are another major factor affecting soil loss. Soil properties most closely associated with erodibility are texture, structure, and moisture content. Texture refers to the relative distribution of the various sized primary soil particles. A fine-textured soil having large amounts of silt and fine sand or highly expansive clay minerals is most susceptible to erosion from rainsplash and runoff. Soil structure, on the other hand, refers to the arrangement of primary soil particles. It influences both the ability of the soil to absorb water and its physical resistance to erosion. Granular structured soils containing large amounts of fine sands and silts with little clay, are usually more erodible than soils with a blocky or massive structure.

(4) Length and steepness of slope - All other factors being equal, a long slope will collect more runoff than a short slope. The more water collected, the greater will be the concentration of water at the base of the slope and, thus, the greater the likelihood of erosion. To minimize this problem, long slopes can be constructed so that they function as a series of short slopes by utilizing diversion structures such as benches, terraces, ditches, or dikes. Steepness of slope, surface roughness, and the amount and intensity of rainfall govern the velocity of the runoff flowing down the slope.

METHODS OF CONTROL

When an area is exposed during construction, the severity of erosion can be greatly reduced if proper control measures are used. Erosion control measures perform one or more of the following functions: minimize soil exposure, control runoff, shield the soil, and bind the soil.

Minimizing soil exposure involves the staging of grading and revegetation so that a minimum of soil surface is exposed at any one time.

Runoff is controlled by the interception, diversion, and safe disposal of runoff. It may also be controlled by decreasing the amount of runoff through special grading practices, the staging of construction activities, and the preservation of natural vegetation.

To shield the soil surface from the impact of raindrops and from the scouring effects of both overland and channelized runoff flow, various surface covers of mulch or paving materials are used.

The binding of soil particles together to make them less susceptible to removal by rainsplash or runoff is accomplished by using both chemical and natural binders. Natural binders include soil products such as clay, organic matter, and the roots of growing vegetation.

An effective tool in controlling erosion is good site planning. This not only involves a judicious selection of control practices, but also includes proper site selection and layout. This idea has been discussed previously in the section of this report dealing with "Site Planning".

Most erosion control practices can be grouped under the following categories: surface roughening, interception and diversion practices, vegetative soil stabilization, and non-vegetative soil stabilization.

(1) Surface roughening - Surface roughening practices, such as scarification, "tracking", and the use of serrated slopes are designed to decrease the amount of runoff as well as slow its movement downhill. These practices reduce the ability of the moving water to detach soil particles and transport them downhill.

Surface roughening by scarification along the contour of a graded slope is an economical means of controlling runoff. The grooves spread the runoff horizontally, slow its movement downslope and increase the infiltration rate (Fig. V-4).

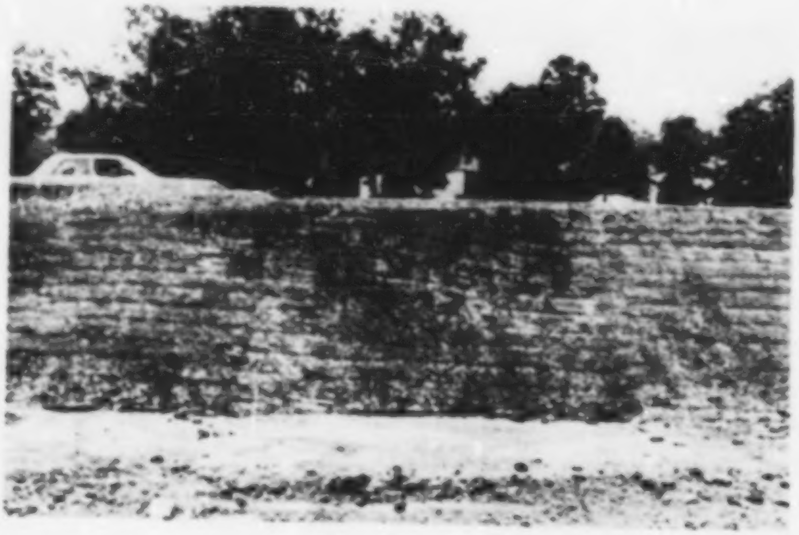

FIGURE V-4 Properly scarified cut slope to control runoff

Moving a cleated dozer up and down a graded slope is another popular means of providing a roughened slope. This practice is referred to as "tracking" and is more adaptable to steep slopes than scarification. It should also be noted that tracking does not loosen the soil as much as scarification. A compacted surface may be more beneficial in some instances, especially on long or steep slopes exposed to high intensity rainfalls.

Serrations made on cut slopes by conventional bulldozers at varying intervals down the slope, referred to as serrated slopes, are sometimes used as a means of reducing the velocity and volume of runoff.

Roughening is also beneficial in the establishment of vegetation on a graded area. The horizontal grooves retain soil additives, seed, and mulch that might otherwise have been washed down the slope. This practice also increases moisture retention and loosens the soil permitting plant roots to develop more readily.

(2) Interception and Diversion Practices - These are practices designed to intercept runoff before it has a chance to come in contact with an erodible soil surface and to divert it to a safe disposal area (Fig. V-5).

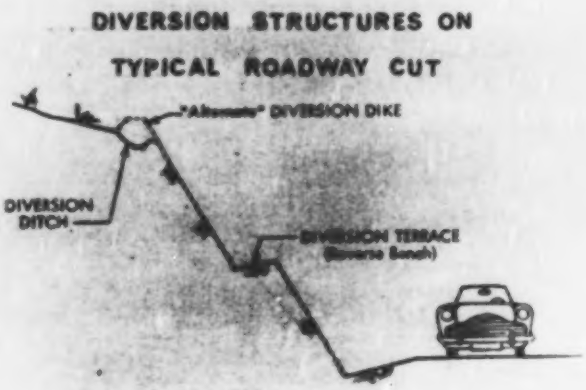
DIVERSION STRUCTURES ON
TYPICAL ROADWAY CUT
"Alternate" DIVERSION DIKE
DIVERSION DITCH
DIVERSION TERRACE
(Reverse Bench)

FIGURE V-5 Typical diversion structures

a. Diversion structures - These structures include soil or stone dikes, ditches, and terraces or benches. They are used extensively at the top of graded slopes to divert off-site runoff away from the erodible surface. Diversion structures are also located on long graded slopes to reduce the amount of runoff coming in contact with the lower portion of the slopes. Reverse benches along highway slopes are good examples of this type of use.

Interceptor dikes are a specialized variety of diversion structure. Their principle use is along graded roadway rights-of-way. They are placed across the right-of-way to intercept runoff and divert it either onto a vegetated area or into a disposal structure or sediment detention structure. The dike is constructed with compacted soil or crushed stone or gravel. The latter materials are preferred when construction traffic must use the right-of-way (Fig. V-6).

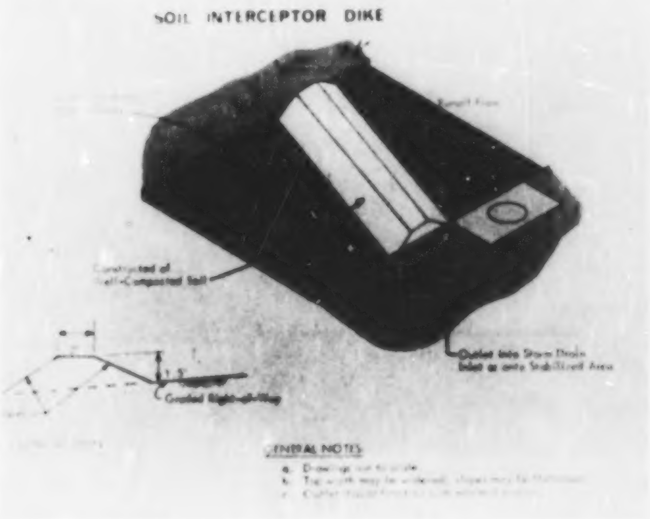
SOIL INTERCEPTOR DIKE
Runoff Flow
Constructed of Well-Compacted Soil
Outlet into Storm Drain Inlet or onto Stabilized Area
Graded Right-of-Way
GENERAL NOTES
a. Drawings not to scale

FIGURE V-6 Interceptor dike on a graded right-of-way

b. Disposal structures - Runoff disposal structures are usually required to safely dispose of the concentrated runoff collected by diversion structures.

Flexible downdrains, sectional downdrains, flumes, and level spreaders are popular means of conducting concentrated flow down a graded slope to a disposal point. Both flexible downdrains and sectional downdrains are manufactured products.[1] The flexible downdrain consists of a metal end-section connected with a flexible fabric tube resembling a large hose (Fig. V-7). In some cases, especially where long term usuage is desired or when freezing weather constitutes a serious maintenance problem, a standard corrugated metal drain pipe is substituted for the flexible tube.

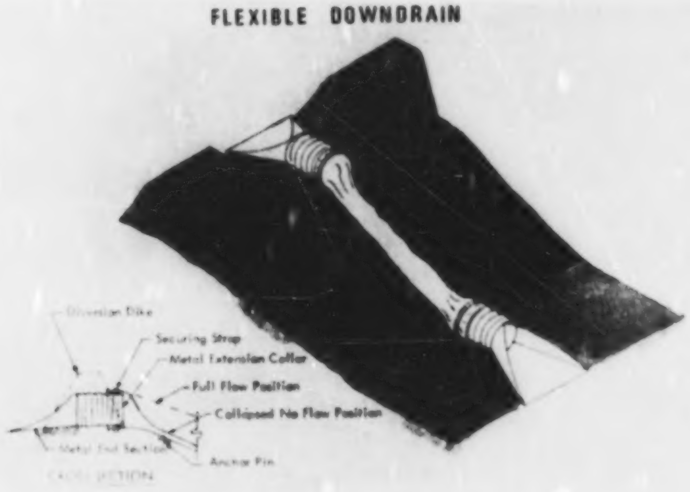
FLEXIBLE DOWNDRAIN
Diversion Dike
Securing Strap
Metal Extension Collar
Full Flow Position
Collapsed No Flow Position
Metal End Section
Anchor Pin
CROSS SECTION

FIGURE V-7 Flexible downdrain

Sectional downdrains are usually half-round pipes constructed of bituminized fiber, concrete, or metal (Fig. V-8).

Flumes, constructed of concrete or asphalt, are not a commercial product (Fig. V-9). Metal flumes, corrugated or plain, are available commercially.

For permanent disposal purposes level spreaders are sometimes used. They usually consist of a bench cut into undisturbed soil in such a manner that the bench plunges back into the hillside, much like a "reverse bench", and the forward edge, or lip is exactly level. The function of the spreader is to collect the concentrated water from the diversion structure and to spill it out over the lower lying, stabilized hillside as nonerosive sheet flow (Fig. V-10).

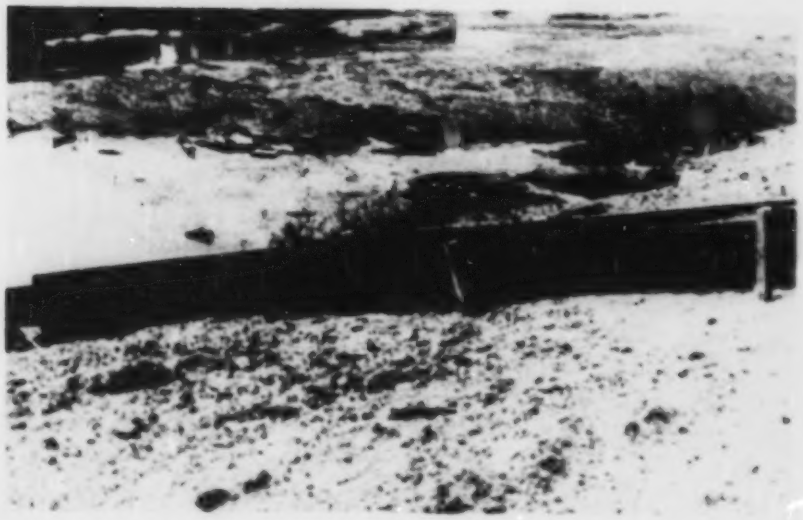

FIGURE V-8 Sectional downdrain

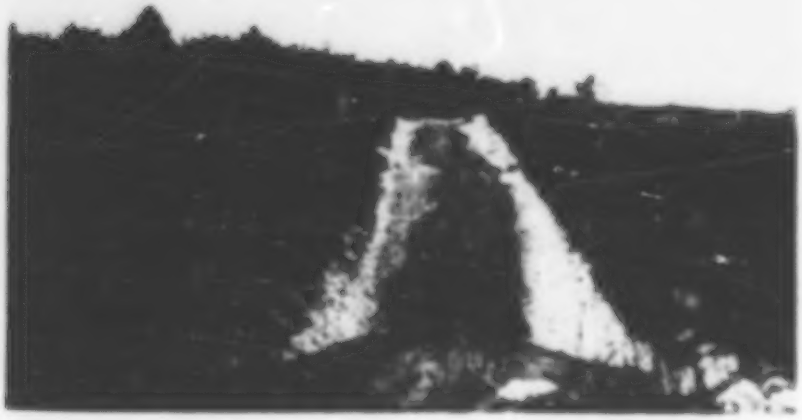

FIGURE V-9 Temporary flume made of concrete

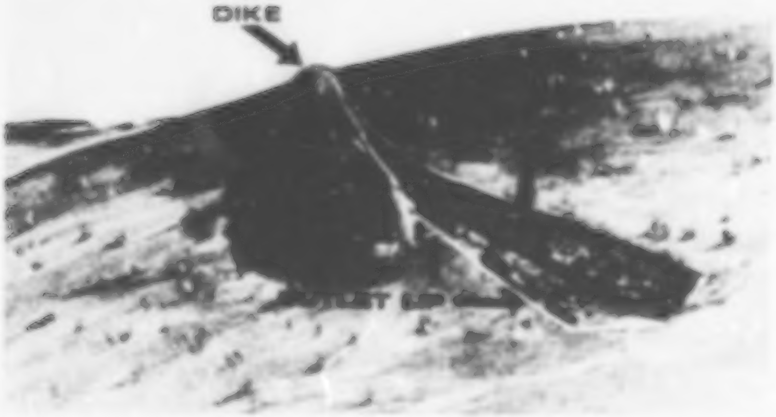
DIKE
OUTLET LIP

FIGURE V-10 Level spreader

(3) Vegetative Stabilization - Vegetation is used both for temporary or short-term stabilization and permanent or long-term stabilization.

a. Temporary Stabilization - Temporary or short-term stabilization involves the use of fast growing annual and perennial plant material to provide interim protection, generally for a period of less than one year. Such use is necessitated by prolonged grading delays and the completion of final grading during seasons of the year when permanent vegetative stabilization cannot be performed (Fig. V-11).

b. Permanent Stabilization - When an area is to be stabilized for a period of generally more than one year, permanent or long-term vegetative soil stabilization is performed. This involves the use of long-lived perennial plant material, selected on the basis of specific site conditions. These materials include grasses, legumes, ground covers, vines, shrubs, native herbaceous plants, and trees (Fig. V-12).

FIGURE V-11 Temporary vegetation using annual rye grass

FIGURE V-12 Herbaceous plants, shrubs, and trees stabilizing slope

The installation of plant material requires good site preparation involving soil preparation and proper planting techniques (Fig. V-13). After the vegetative cover becomes established, regular maintenance is required to achieve a long-term cover that adequately controls soil erosion. A point to remember, however, is that plant materials vary in the amount of maintenance required to sustain them. On inaccessible slopes, the use of a low maintenance cover is desirable from the standpoint of erosion control economics (Fig. V-14).

(4) Non-vegetative Soil Stabilization - As in the case of vegetative soil stabilization, non-vegetative soil stabilization includes both temporary and permanent stabilization.

FIGURE V-13 Application of grass seed on graded slope

FIGURE V-14 Crown vetch (perennial legume) applied to steep stream bank slopes

a. Temporary Stabilization - Temporary stabilization involves the use of various coverings and binders that either temporarily shield the soil surface from rainfall impact and runoff or temporarily bind the soil particles into a more resistant mass. Included in this sub-category of control practices are mulches, nettings, and chemical binders.[1] Customarily, these practices are used either to provide temporary protection while a more permanent vegetative cover is developing (mulching) or to provide interim protection during grading delays or until a long-term vegetative cover can be established (Fig. V-15).

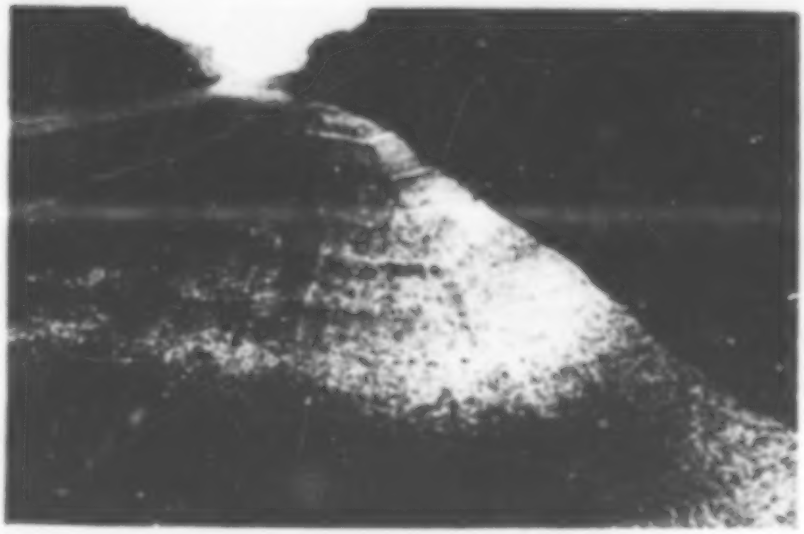

FIGURE V-15 Temporary netting on a roadway ditch

(b) Permanent Stabilization - Permanent stabilization becomes necessary when erosive or climatic conditions, or other factors, preclude the use of vegetation. Areas commonly requiring this treatment include: excessively steep slopes, graded areas containing groundwater seepage, droughty soil or toxic soil conditions, soil surfaces in waterways exposed to high velocity concentrated flow, and shore lines receiving high energy wave impacts.

In upland areas permanent non-vegetative stabilization usually consists of a protective blanket of coarse crushed stone, gravel, other durable materials. When slope steepness exceeds the natural angle of repose of these materials, or when serious sliding or sloughage are likely, more rigid structures are required. These are usually concrete, wooden, or metal retaining structures or pavements of concrete or asphalt.

In waterways, a number of structural treatments are often utilized.[1] These consist of bank protection structures and grade stabilization structures that help control channel erosion or down-cutting. Bank protection structures are used normally along natural streams and consist of either a protective revetment placed directly on the bank or in-channel structures that deflect or dissipate the velocity of the flow impinging upon the bank (Fig. V-16).

Grade stabilization structures usually consist of a series of check dams or energy dissipators that both dissipate the energy of the flowing water and physically restrict down-cutting of the channel (Fig. V-17).

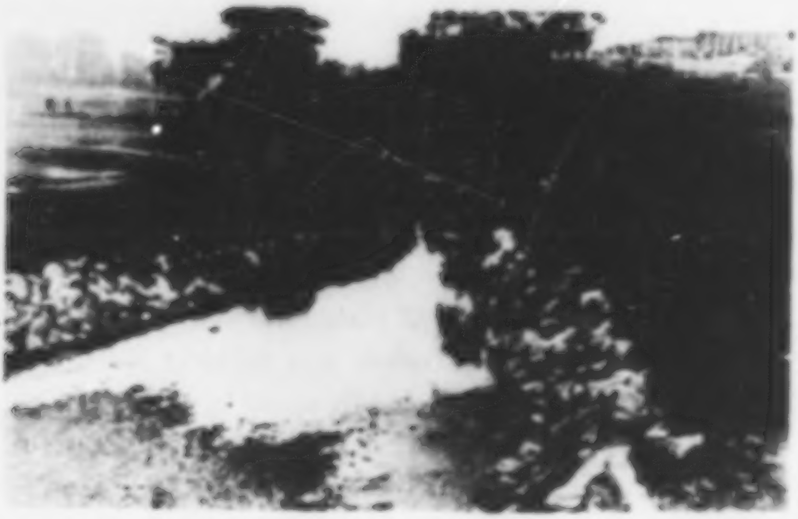

FIGURE V-16 Streambank protected by stone rip-rap

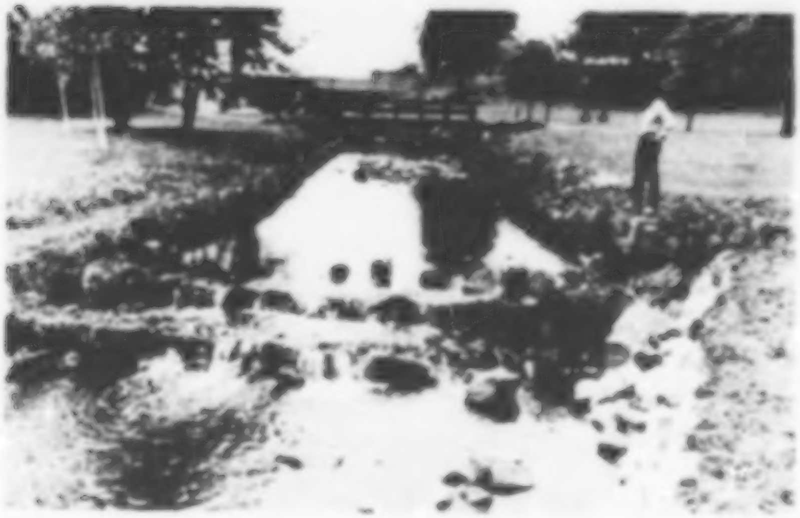

FIGURE V-17 Gabion check dam and bank protection

Where both bank and channel erosion are a problem, complete channel linings are sometimes used. A note of caution on the use of linings is that they should incorporate means for dissipating flow energy in order to prevent the occurence of serious erosion at the downstream terminus of the structure. Lining with materials such as riprap may be chosen to dissipate the energy.

A number of materials are used to construct grade stabilization structures in waterways. These include stone (used both as riprap or in wire "gabion" [1] baskets), concrete (used as rip-rap, interlocking blocks, paving, or in concrete filled mattresses), and wood.

Shore protection structures resemble the structures used to protect stream banks. Normally, they are revetments of stone or concrete.

STRUCTURAL DESIGN AND CONSTRUCTION

Structures used to handle concentrated runoff in most cases require a formal design and, in all cases, must be properly installed. It must be emphasized that these structures represent only part of the overall effort to control erosion and sedimentation and that the structural design must be closely coordinated with the vegetative design. Temporary structures may not require a specific design. Standards and specifications that establish uniform criteria for these structures can generally be obtained from the local soil and water conservation district. Permanent structures used to control runoff during and after development, on the other hand, will need a formal design.

Those responsible for the design of structural practices should evaluate the conditions existing on the construction site. If a standard design for a temporary practice is to be used, a check on the conditions at the site should determine if this standard criterion is adequate. If not, more stringent criteria should be used.

Some of the considerations involved in the design of various practices include the following:

(1) For diversion structures that intercept and divert runoff from a graded area (dikes, ditches, and terraces) -

a. The amount of surface runoff being diverted should not be allowed to overtop the dike.Standard procedures for estimating this quantity are available from several sources.[3-6]

b. The grades should provide positive drainage to the outlet.

c. The grades usually require vegetative or mechanical stabilization. This is normally the case when the ground slope is more than two percent along the dike and a long service life is desired.

d. Excessive grades should be eliminated inasmuch as they are likely to result in excessive velocities that could cause erosion.

e. The diverted runoff must be discharged directly onto an already stabilized area or through grade stabilization structures capable of handling the quantity being discharged.

f. When erecting a diversion across a graded right-of-way used by construction traffic, a gravel interceptor dike should be used to provide adequate support.

(2) For level spreaders which will disperse the concentrated flow created by a diversion structure onto a vegetated zone -

a. The length of the spreader will be dependent upon the amount of water to be disposed. Tables relating the amount of runoff to the length of the spreader can be found in the Soil Conservation Service Manuals.[7] The designer need only compute the amount of runoff and select the length of spreader from the tables.[3-6]

b. The outlet lip is the most important feature of the level spreader. The lip must be exactly level along the entire length of the spreader in order to evenly spread the water over the entire outlet lip. Failure to meet this requirement will cause the flow to be concentrated in the low areas.

c. The excavation for the spreader must be well stabilized with vegetation prior to use.

d. The addition of a long-lasting erosion control netting, such as fiber glass netting, on the outlet lip would be a further guarantee against erosion damage.

(3) For downdrains which will carry the water down a graded slope to a disposal area without causing erosion -

a. The size of the structure is based on the amount of surface runoff to be disposed and the hydraulic properties of the structure's cross section.

A number of charts and design aids are readily available which relate the amount of discharge to the geometric problems of the structure, thereby facilitating the design procedure.[3-6]

b. Inlet and outlet conditions must be thoroughly investigated.

c. Soil must be tightly compacted around the inlet to prevent piping failure. Piping is the flow of water along the outside of the inlet instead of on the inside.

d. Care must also be taken in the design to prevent the water leaving the outlet of the structure from causing erosion. The disposal area should be well stabilized with vegetation. When the runoff contains sediment, it should be disposed of above a sediment trap.

e. If the outlet cannot be located so that it discharges onto a well vegetated area, it will be necessary to provide some type of energy dissipator at the end of the downdrain. The function of an energy dissipator is to slow the flow of water and thereby decrease the chance of erosion as the water enters onto the soil surface. The most popular type of dissipator is an apron of large stones or broken concrete, or a designed structure that provides a hydraulic jump and a loss of energy.

VEGETATIVE DESIGN

Vegetative design considerations are just as important as those for structural design. Erosion and sedimentation hazards can be minimized on construction sites by the proper integration of vegetative stabilization practices with mechanical structures.

Site factors most often limiting the successful establishment of plants on exposed subsoils typical of construction sites include the soil chemical and physical properties,and the biological features of the site.

Prime soil chemical factors refer to the supply of soil nitrogen, phosphorus, calcium, magnesium, potassium, and trace elements. Among the trace elements, aluminum and manganese toxicity can be a problem in many soils of the temperate and humid subtropical regions where the soil pH is in the strongly acid zone (pH4.5). Among the major essential plant nutrients, soil nitrogen is most often limiting to plant growth (in the Northeastern, Southeastern, and Southwestern United States) followed by the amount of available soil phosphorus. The best way to cope with these potential problems is to collect representative samples of the A, B, and C horizons of the various soil types found on the construction site during the preliminary site evaluation. Soil analysis can be conducted by private soil testing laboratories for soil pH, phosphorus, potassium, magnesium, and other plant nutrients. Assistance in the interpretation of soil test data can be provided by the soil conservation district or State agricultural experiment station experts. Results from these tests can be used to establish the correct amount and frequency of application of commercial fertilizers and limestone for successful plant growth. The soil tests conducted on the A horizon (and upper B horizon) usually to a depth of 15 cm., can be helpful in evaluating the quality of the topsoil often set aside in topsoil stockpile areas.

Prime soil physical factors often limiting to plant growth are the supply of available soil moisture, soil texture, porosity, aeration, structure or compaction, slope angle and exposure, and soil temperature. Soil samples collected for chemical tests can be used to estimate the silt plus clay contents of the A, B, and C horizons. This soil property essentially determines the moisture retention capability of topsoil and subsoils. Soils having a silt plus clay content of less than 25 percent, or more than 85 percent, can be expected to present serious problems for successful plant growth. Where this soil problem is encountered, it should be referred to the local soil conservation district soil and plant scientists. Soil compaction produced by traffic of heavy machines can be relieved during the preparation of a proper seedbed by use of deep tillage and soil scarifying machines.

Optimum success in establishing plants on slopes is achieved where slope angles do not exceed 3 horizontal to 1 vertical (33 percent slope).[2-8] Exceptions do exist, however. Highway slopes of 1:1 (100 percent slope) in the mother lode country of California (consisting of basic soils) have been successfully revegetated.[9] For most soils having a silt plus clay content greater than 85 percent, cut slope angles should be kept as flat as possible, because these soils possess small pores which create problems for plant root penetration and water infiltration.

Slopes having southerly or southwestern exposures should be planted to heat and drought resistant grasses and legumes. Avoid planting cool season grasses and legumes on any but the northerly and easterly slopes.

Prime biological factors refer largely to the incidence of plant diseases and insects attacking plants used to stabilize exposed soils. Assistance on these problems can be obtained from county agents, soil conservation districts, and others expert in entomology and plant pathology.

Ordinarily, there are few problems from plant diseases and insects among the grasses most widely used for soil stabilization.

Useful criteria for selecting plant materials for stabilization of soils on construction sites are:

(1) high degree of resistance to heat, cold, insects, and diseases

(2) potential for rapid lateral shoot and root growth sufficient to quickly fill its niche

(3) capacity for low, compact growth habit

(4) potential for nitrogen fixation by root system

(5) low maintenance requirements

(6) high drought resistance

Major knowledge gaps are evident with respect to the successful establishment and maintenance of grasses, legumes, and woody plants on urban and other construction sites.[10] Assistance on the selection of grasses, trees, and shrubs suitable for various regions can be obtained from the local soil conservation district, and from the offices of the Soil Conservation Service.

Other site factors often limiting successful establishment of plants refer to the intensity and duration of sunlight, and ranges in seasonal temperature, rainfall, and wind velocities on different construction sites. Because of the relatively fixed path of the sun's motion, different slopes receive different amounts and durations of sunlight. Slopes facing southward receive the most sunlight. North-facing slopes receive the least. Wooded areas and tall buildings can intercept sunlight and alter the duration of sunlight. During the planning stage, these conditions should be identified early and selections made of plants adapted to shade, or tolerant of relatively long periods of low light intensity.

The seasonal ranges of air temperature and rainfall distribution often vary widely within different parts of the same state.

These factors must be taken into account, since they determine the latest frost-free planting dates, periods of most intense rainstorms, and the most likely drought periods. In areas (urban and rural) where hot, dry, or cold winds are common during the growing season, extra effort will be needed to choose plant species adapted to these climatic excesses.

EFFECTIVENESS ANALYSIS

To date, little research has been conducted to determine the universal or nationwide effectiveness of individual or combined controls. This is largely because of limited field exposure, a still developing "state-of-the-art", and problems associated with regional variables. In most instances, the data being compiled have only regional applicability. Table 1 is an example of such a regional data compilation, showing the effectiveness of various ground covers at construction sites in Fairfax County, Va.[11] These results suggest comparable effectiveness between vegetative and non-vegetative stabilization methods.

In other work, a model watershed in Montgomery County, Maryland was used for developing methodology for evaluating the economic impact of erosion and sediment controls during urbanization. The effectiveness of various treatment alternatives was estimated largely by use of the Universal Soil Loss Equation.[12] Surface land treatment and structural controls were evaluated as a means of optimizing erosion and sediment control systems.

There is a real need for continuing research in determining the effectiveness of various control measures. Research dealing with localized conditions in different parts of the country is needed because trends and comparisons can be established with respect to various control structures and practices.

TABLE V-1. EFFECTIVENESS OF GROUND COVER ON EROSION LOSS AT CONSTRUCTION SITES IN FAIRFAX COUNTY, VIRGINIA

KINDS OF GROUND COVER	SOIL LOSS REDUCTION RELATED TO BARE SURFACES (percent)
Vegetative Stabilization*	
Permanent grasses	99
Ryegrass (Perennial)	95
Ryegrass(Annual)	90
Small Grain	95
Millet & Sudangrass	95
Field Bromegrass	97
Grass Sod	99
Non-Vegetative Stabilization	
Hay (4485 kg/ha; 2 tons/acre)	98
Small Grain Straw (4485 kg/ha; 2 tons/acre)	98
Corn Residues (8970 kg/ha; 4 tons/acre)	98
Wood Chips (13,455 kg/ha; 6 tons/acre)	94
** Wood Cellulose Fiber (3364 kg /ha; 1 3/4 tons/acre)	90
** Fiberglass (1120 kg/ha; 0.5 tons/acre)	95
** Asphalt Emulsion (1167 liters/ha; 125 gals./acre)	98

* Based on fully established stand

** Experimental - not fully validated

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VI. SEDIMENT CONTROL

OVERVIEW

Sediment control relates to that portion of the overall erosion and sediment control program dealing with sediment generated by unpreventable erosion. It must be understood that we can only expect "reasonable" erosion control. Thus, even with the best plan, some erosion must be anticipated. This being true, some sediment will be generated. Accordingly, there is a need for a second line of defense on construction sites to minimize sediment damage.

The combined processes of soil detachment, dispersion, transportation, and eventual deposition are referred to as sedimentation. This section will deal only with the transportation and deposition process. Detachment was covered under "Erosion Control."

The detached soil particles are transported both as suspended sediment and bedload sediment. The suspended sediment is comprised of inorganic soil particles (fine sand, silt, and clay) and organic particles carried and supported by the water itself. Bedload sediment, on the other hand, refers to the coarser particles of soil that slide, roll or bounce along the channel bottom.

The nature and extent of sediment transportation and deposition is largely determined by three basic factors: characteristics of flow, properties of the particles, and character of the fluid.

(1) Characteristics of Flow - The characteristics of flow relate mainly to the velocity, turbulence and the quantity of the water. As these flow characteristics increase, the water not only has a greater potential for eroding soil, but also an increased potential for transporting the soil. When these characteristics decrease, the potential of the moving water to erode and transport

also decreases, resulting in deposition of sediment particles.

(2) Properties of the Particles - These relate to the actual size, shape and density of the particles in the water. Smaller, lighter particles, such as fine sand and clay, are more easily transported by water than coarser particles. The coarser particles, on the other hand, are more quickly deposited.

(3) Character of the Fluid - This relates to the density of the transporting fluid. Density influences the ability of the water to hold the particles. This holding ability is called bouyancy.

METHODS OF CONTROL

There are two basic types of sediment control practices - vegetative and structural. Vegetative controls are intended to filter and retard overland flow so that deposition occurs. When vegetative practices will not by themselves provide the desired degree of protection, or when flow becomes concentrated as it does in drainage structures, structural controls must also be utilized.

Sediment control practices are designed to slow the flow of runoff water by filtering and ponding. By so doing, the ability of the water to transport sediment is reduced and sediment settles out. The amount of sediment removed by filtering depends upon the nature of the flow and the degree of filtering action provided. For practices that do not involve filtering, the amount of sediment that is removed is largely dependent on factors of the flow velocity through the structure, the length of time the water is detained in the structure, and the size and weight of the sediment particles carried into the structure. Some detention structures are capable of removing only the coarse textured sediment, whereas the larger more sophisticated structures, such as ponds, can remove appreciable quantities of the finer textured material as well.

(1) Vegetative Control Practices - The principle types of vegetative practices include vegetative buffers and the sod inlet filter. Buffers are used to detain, absorb, and filter overland runoff and thus remove sediment from the water. They include natural vegetative buffers, installed vegetative buffers, and contour strips or buffers.

a. Natural Buffers - The use of natural vegetative buffers involves the preservation and protection of a strip of natural vegetation, consisting of grasses, herbaceous plants or a woodland located along natural waterways. (Fig. VI-1).

FIGURE VI-1 Planning for the preservation of a natural vegetative buffer

b. Installed Vegetative Buffer - Where the existing vegetation will not form a satisfactory buffer or where an open waterway is constructed, an installed buffer is used. This is accomplished by staging the grading and revegetation so that a strip on either side of the waterway is quickly graded, roughened, and revegetated prior to the initiation of grading in upland areas. Use of such buffers between cut or fill slopes and drainage swales can significantly reduce the quantity of sediment carried into waterways by overland flow (Fig. VI-2). Flattening the slope in the buffer area will further reduce sediment pollution. This practice will be discussed further in this section under "structural practices."

FIGURE VI-2 An installed buffer between an exposed graded slope and a waterway

c. Contour Strips - This consists of placing vegetative strips, usually sod, at intervals along the contour of a graded slope to filter flow and check erosion.

d. Sod Inlet Filter - This is constructed by placing grass sod around a storm drain inlet (Fig. VI-3). Like the buffer and the contour strip, its purpose is to filter sediment out of overland flow. It should not be utilized when heavy sediment loads are anticipated. More elaborate traps are required to effectively handle heavy loads.

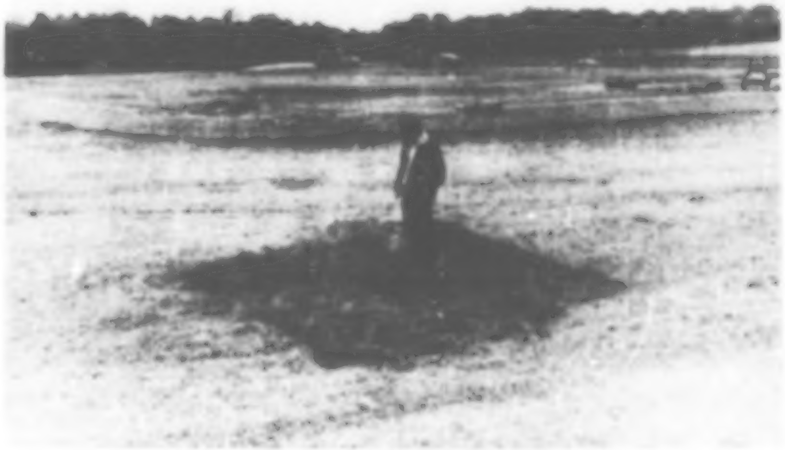

FIGURE VI-3 Sod inlet filter

(2) Structural Control Practices - Sediment control structures include filters, traps, basins and diversion structures.[1] These practices vary widely in cost, complexity, and effectiveness. Commonly used filters include the gravel inlet filter and the filter berm. Both are constructed out of coarse crushed stone or gravel and are usually only effective in removing the coarser textured sediment.

a. Gravel Inlet Filter - As the name implies, this is simply a pile of stone or gravel placed around or in front of an inlet (Fig. VI-4). The filter berm is a large stone or gravel dike placed across graded areas where runoff concentrates or at the disposal points along diversion dikes. The function of both filters is to temporarily detain runoff and filter out sediment. Since these structures are constructed of coarse crushed stone or gravel, they are highly resistant to erosion when over-topping occurs.

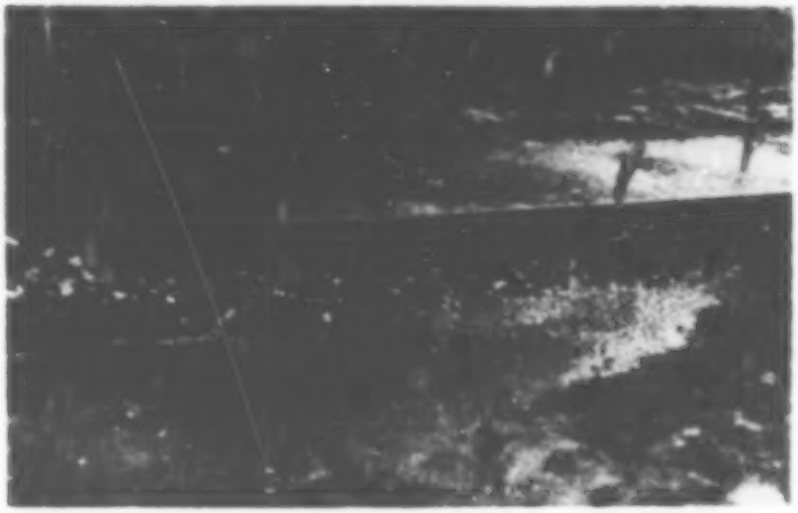

FIGURE VI-4 Gravel inlet filter

b. Sediment traps - These are generally thought of as the smaller detention structures used to trap the coarser, more damaging sediment. These include straw bales or sand bags placed across small drainageways to detain runoff and filter sediment (Fig. VI-5). Excavated traps may be placed around storm drain inlets (Fig. VI-6)and in ditches and other small drainageways. When these structures are positioned at regular intervals along a drainageway, or at storm drain inlets, a high degree of trapping efficiency can be achieved. Another structure called a stone trap can be placed across stream channels to temporarily detain flow and trap sediment. This type of trap consists of a dike of randomly placed stone,sized according to expected flow rates.

c. Sediment basins - These are used on larger drainageways and consist of temporary or permanent impoundments constructed by damming a waterway, by excavating a large depression, or a combination of both.

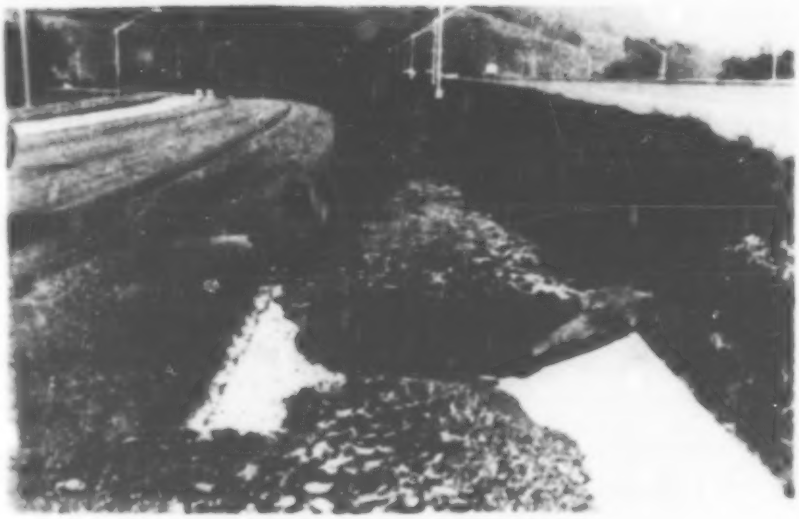

FIGURE VI-5 Sand bags placed across a small drainageway

FIGURE VI-6 An excavated sediment trap

Whereas the filters and traps are on-site practices, these structures comprise the perimeter or outer defense line against off-site sediment pollution. When properly designed, constructed and maintained sediment basins are capable of removing a significant quantity of both coarse and fine textured sediment from stormwater runoff.

Sediment basins are commonly referred to as "dry basins" or "wet basins". Dry basins temporarily detain runoff (Fig. VI-7) and thus allow sediment to settle out of suspension, whereas wet basins are ponds that provide additional storage for stormwater, but do not drain dry (Fig. VI-8). Through good planning these structures can provide pollution protection even after the construction is complete. If properly designed and positioned, both types of structures help reduce downstream channel erosion and the resulting sediment pollution.

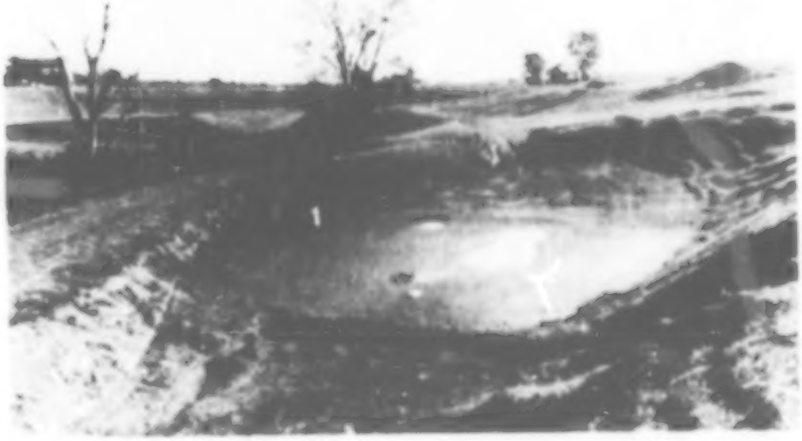

FIGURE VI-7 A "dry basin" partially filled with sediment

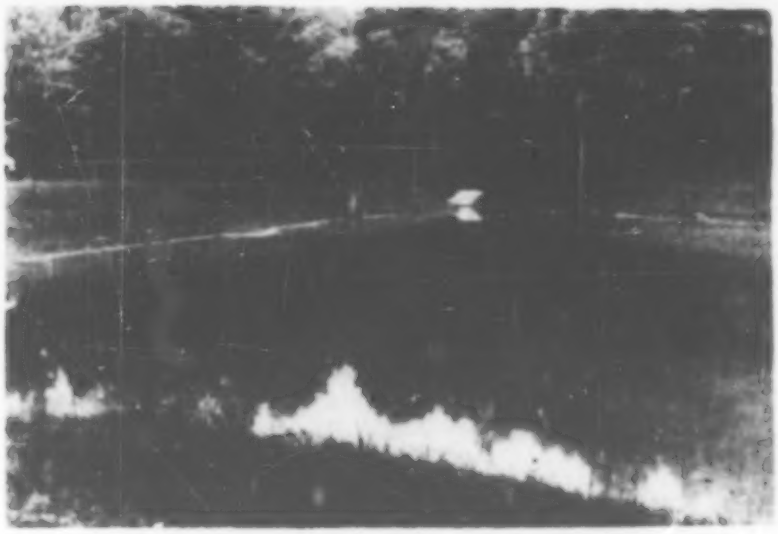

FIGURE VI-8 A "wet basin" trapping sediment

d. Diversion structures - These include dikes, ditches, and terraces, used in sediment control as well as in erosion control. This is the case when the structure is used to intercept sediment laden runoff coming from a graded area and to divert it to a safe disposal area (Fig. VI-9). The disposal area, in this case, would normally be a basin, trap, or filter. In many instances, a diversion structure will function partially as a trap. This happens when the gradient behind or within the structure is low.

(3) Specialized Sediment Control Techniques - These refer to channel relocation and water treatment.

a. Channel Relocation - Where construction occurs on a floodplain, as in the case of dams, channel relocation is sometimes a means of reducing sediment pollution. This practice, however, can cause channel degradation if the gradient is increased. To minimize sediment pollution from the

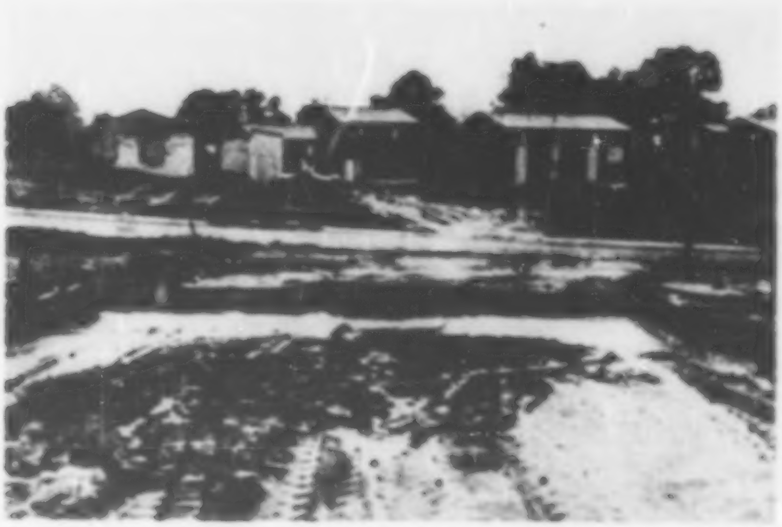

FIGURE VI-9 An interceptor dike impounding runoff and diverting it to gravel inlet filters

excavation work for the new channel, plugs are left at both the upstream and downstream ends.[2] When all interior grading and stabilization is complete, first the downstream plug, and then the upstream plug is removed. Once water is flowing through the new channel, the old channel is sealed off or completely filled with gravel or earth material in the channel.

b. Water Treatment - Some areas undergoing considerable construction activity may require treatment of the runoff to remove sediment. This is normally accomplished by either the use of a water clarifier or a temporary treatment plant capable of using chemical additives to flocculate the sediment.

The water is usually diverted to a pond and then pumped to the system to undergo treatment. After treatment the water is discharged into the waterway. These types of treatment are expensive and generally would only be justifiable on large construction sites where the possibility of serious pollution exists and where other less sophisticated and costly techniques cannot be employed. Nearness of the construction to the receiving water is another factor influencing the need for water treatment.

DESIGN, CONSTRUCTION, & OPERATIONAL CONSIDERATIONS

In the installation of a vegetative buffer or contour strip, consideration should be given to the susceptibility of the cover to temporary on-site water inundation and sediment deposition. The type of vegetative cover used should be deep-rooted and be able to adjust to the low oxygen levels caused by this periodic flooding and sediment covering. The plant materials used to detain and filter this runoff should be perennials intermixed with fast growing annuals seeded at a low rate, to allow establishment of the perennial species.

Sediment control structures, such as inlet filters and other small structures, may not require individual design as standard designs may be applicable. They should, however, be constructed carefully to provide maximum site protection. On urban construction sites and major highway projects where storm drains are used, the prevention of sediment damage to the drainage system becomes a particularly important task. Failure to take adequate measures to trap much of the sediment before it reaches an inlet may lead to costly damage to the storm drainage system. Some of the considerations for installation of these practices are as follows:

(1) For a gravel inlet filter made of crushed rock or gravel to trap sediment prior to entering the inlets -

a. the configuration of the gravel inlet filter will depend on the type of inlet being protected.

b. The throat opening of curb inlets should be protected either with concrete block or a board placed across the opening with a space of at least 1.3 centimeters (one-half inch) at top and bottom. This will prevent the stone or gravel from falling into the storm drain.

c. The clogged filter material should be cleaned or replaced after each storm.

(2) For sediment traps, such as sand bags and straw bales, that can be used either at stormdrain inlets or in minor swales or ditches -

a. The sandbags should be stacked in an interlocking fashion to provide additional strength for resisting the force of the flowing water.

b. The service life of the straw bale trap can be prolonged by using wire-tied bales rather than those tied with twine.

c. In constructing the straw bale trap, the bales are laid on their sides and staked in place. At least two wooden or metal stakes are driven through each bale and into the ground.

d. Piping is a major cause of failure. The possibility of piping failure can be greatly reduced by setting the sandbags or straw bales in a trench excavated to a depth of at least 15 centimeters (6 inches) and by firmly tamping soil along the upstream face of the trap.

e. Periodic inspection and very prompt maintenance of these structures is essential if they are to function adequately.

(3) For a sediment basin requiring a formal design - Standard design criteria may vary from one state to another and can usually be obtained from the local soil conservation district. In Maryland, for example, the sediment basin designer will take

into account the following rule of thumb considerations:[3]

a. The site should be selected to provide adequate storage for not less than 1.3 centimeters per hectare (0.5 inches per acre) of drainage area. The sediment basin should be cleaned out when the effective storage capacity drops below 0.5 centimeters per hectare (0.2 inches per acre) of drainage area.

b. The combined capacity of the pipe and emergency spillway should be designed to handle a ten year frequency storm on drainage areas of 8 hectares or less (20 acres or less). Runoff should be computed by an acceptable method), and should be based on soil cover conditions expected to prevail during the anticipated effective life of the structure.[4-7]

The hydraulic efficiency of the pipe spillway can be increased by using a riser with a cross sectional area of at least 1.5 times the cross sectional area of the horizontal pipe.

The crest of the riser must be properly positioned. When used in combination with an emergency spillway, the crest elevation of the riser should be at least one foot below the elevation of the control section of the emergency spillway. If no emergency spillway is provided the crest elevation of the riser should be at least 91 centimeters (3 feet) below the crest elevation of the embankment. Freeboard for a sediment basin without an emergency spillway should be at least 60 cm. (2.0 feet) where freeboard is defined as the difference in elevation between the design highwater and the top of the settled embankment.

An antivortex plate and trash rack should be attached at the top of the riser pipe to increase the intake capacity of the pipe and at the same time to minimize the possibility of trash blockage.

The riser should have an anchor attached to its base with a water tight connection. The anchor must be of sufficient weight to prevent flotation of the riser.

Conduits beneath embankments consisting of materials with low silt-clay fractions should be provided with anti-seep collars where the pipe diameter is 25 centimeters (10 inches) or greater. For dry structures a perforated riser pipe should be used with a suitable filter device.

c. The minimum capacity for an emergency (earth) spillway will be that required to pass the peak flow from a design storm less any reduction passing to the pipe spillway. Charts and tables are available to facilitate design.[3] The embankment and spillway should receive adequate vegetative stabilization. Velocities in the exit channel should be low enough so that they do not cause any damage. Freeboard should be 30 centimeters (1.0 foot) for a sediment basin with emergency spillway.

d. The designer must consult the local specifications for compliance with minimum top width and side slope requirements of the embankment.

e. Various miscellaneous considerations include:

-Close control must be provided to insure that proper construction practices are employed.

-Only suitable soils must be used to construct the dam using a good degree of compaction.

-Periodic maintenance of the basin is essential. The designer should indicate at what elevation cleaning will be required.

MAINTENANCE

The most important element of maintenance practice, whether in reference to vegetative or structural measures, refers to the indication in contract and development plans of clear cut lines of responsibility for the installation of these measures at specific times and places on the construction site. Closely related to this is the assignment by the contractor, of people who understand the importance of well defined on-site inspection routines. By this is meant that some sediment control structures such as sandbag and straw bale sediment barriers require daily inspection because they are subject to vandalism. Diversion dikes, filter berms, flexible downdrains, interceptor dikes, level spreaders, sediment retention basins or ponds, and other structures require inspection after each rainstorm. Without exception, it is safe to say that the best time to inspect most vegetative and structural practices following initial installation, is when a major storm event is actually in progress. Corrective decisions made on-site at this time can reduce sediment damages and operating costs in the long run.

With regard to revegetation practices, it is important to establish a multi-step program of application of fertilizers following the initial liming, seeding, and mulching steps. In areas where revegetation failed initially, it is important to determine what corrective measures are needed and then carry them out. Maximum vegetative stabilization of all exposed soils, whether of a temporary or permanent nature, is of the utmost importance.

Relative to sediment control structures, it is most important to develop a routine schedule for the removal of sediment from settling ponds and sediment basins. An integral part of this schedule is the disposal of the sediment in a manner that will preclude its return to downstream areas during runoff storm events. A rule of thumb for arriving at a cleaning out time for a settling pond is when it has reached 50 percent of its sediment storage capacity. Sediment removed from a settling pond can be disposed of behind a protective berm or grass filter strip. Where larger quantities of sediment are removed, as from sediment basins, it will be necessary to obtain guidance from people who are expert in these matters.

EFFECTIVENESS ANALYSIS

Based on the present state-of-the-art, it is difficult to assign an accurate universal effectiveness value to a sediment control practice or combination of practices. This is because of the many complex factors influencing effectiveness. These include soil erodibility, climate, types of control practices being used, physical characteristics of the sediment, and flow characteristics, to name a few. Another factor is the near absence of adequate standard design and construction criteria for many of the sediment control practices for different slope conditions. Where standard design procedures do exist, as in the case of sediment basins, a more accurate assumption could be made as to effectiveness. Techniques are available for determining trapping efficiency in large reservoirs.[4] This technique may be applicable to large sediment impoundments. Sediment basins are generally designed to have a minimum of 70 percent effectiveness.

A technique has been developed for determining the effectiveness of practices or combinations of practices using the Universal Soil Loss Equation.[8] It will provide a general measure of the effectiveness of a particular procedure versus no procedure.

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VII. POLLUTANTS OTHER THAN SEDIMENT

OVERVIEW

The major water pollutant generated on construction sites and other nonpoint or area sources is considered to be suspended sediment (both mineral and organic solids) most commonly dispersed and transported from its site of origin into streams by the action of water and wind. [1] Potential pollutants other than sediment associated with construction activity include pesticides (insecticides, fungicides, herbicides, and rodenticides), petrochemicals (oil, gasoline, and asphalts), solid wastes (paper, wood, metal, rubber, plastic, and roofing materials), construction chemicals (acids, soil additives, and concrete curing compounds), wastewater (aggregate wash water, herbicide wash water, concrete cooling water, coredrilling wastewater, and cleanup water from concrete mixers), garbage, cement, lime, sanitary wastes, and fertilizers. [2]

Practices must be used that prevent these potential pollutants from leaving the construction site. Good erosion and sediment control, coupled with stormwater management, will deter the movement of large amounts of sediment off the site. But it must be recognized that pollutants carried in solution, in runoff water, on sediment by adsorption, in solid organic materials, as metallic coatings, or fixed within sediment crystalline structures (e.g., crystalline clays) will be carried through the erosion and sediment control defenses. Recent work shows that the trace metals copper, cobalt, and chromium are transported in rivers largely by fixation within sediment crystalline structures. On the other hand, manganese, iron, and nickel are transported largely as metallic coatings on sediment particles. [3] Pollutants such as oils, waxes, and water insoluble pesticides form surface films on water and on solid particles. Oil films, as a matter of fact, serve as a medium for concentrating water insoluble insecticides.

Other than by use of very costly water treatment facilities, or long runoff water-detention periods, these pollutants become nearly impossible to control once present in the runoff. The most economical and effective controls for pollutants other than sediment generated on construction sites, are the exercise of good "housekeeping" practices, and an awareness by construction workers, planners, engineers, and developers of the need and purpose for compliance with Federal, State, and local regulations. For example, most pesticides can kill forms of life other than their pest targets. Certain insecticides can persist for a long time in soil and water, and many toxic chemicals can be passed along plant and animal food chains.[4] Similarly, high levels of nutrients (principally phosphorus and nitrogen) from fertilizers used to revegetate exposed subsoils in graded areas, may enter waterways and increase the growth of phytoplankton at the surface to such an extent (extreme enrichment) that light penetration in the water column is decreased. The end result of overenrichment in large bodies of water is decreased productivity. In confined water bodies, overenrichment can lead to complete deoxygenation of the water and ultimate loss of fish and other living forms. Ways must be found to protect ponds, lakes, streams, and coastal and estuarine waterbodies from damage by sediment and other pollutants generated during construction activities.[5]

The variety of pollutants and the severity of the damage they cause depend upon a number of factors. The most significant of these include:

(1) The nature of the construction activity

(2) The physical characteristics of the construction site, including such factors as climate, topography, soil condition, drainage systems, etc.

(3) The quantity and quality of the receiving waters (that

is, the amount and purity of the water receiving the contaminated runoff).

It is reasonable to expect, for example, that potential pollution resulting from fertilizers used during revegetation would be more severe on a highway or a housing development than for a shopping center development. This is because highways and housing developments usually have far greater landscaping requirements than shopping centers which are composed mostly of rooftops and pavement.

The physical characteristics of the construction site have a major bearing on the potential severity of pollution from construction activities. As in the case of sediment, the vast majority of all pollutants are carried into the receiving waters via runoff. The amount of runoff coming from a construction site is dependent upon hydrologic factors. These include the amount, intensity and frequency of rainfall, the infiltration rate of the soil, surface roughness, and the length and steepness of the ground slope. Large areas denuded or stripped of vegetation, long slopes, steep slopes, tight soils, and high intensity rainfall are all factors conducive to heavy runoff.

Another physical factor influencing the severity of pollution is the proximity of the pollutant, or potential pollutant, to the receiving water. For example, fertilizers applied to a stream bank are more apt to cause water pollution than fertilizers applied to a slope well upland of the waterway.

Infiltration of stormwater runoff into the soil is a natural means of controlling surface water pollution, but it could lead to groundwater pollution. Infiltration refers to the passage of water into the soil. Bacteria, organic residues, and dissolved chemicals carried into the soil by water are often trapped in the upper soil horizons. The effectiveness of the soil in trapping such pollutants is dependent upon soil characteristics, hydrologic factors, and nature of the pollutant.

Some nonpersistent chemicals and residues are effectively broken down by soil organisms into other products that can be used by plants and other organisms. However, persistent chemical pollutants which are not broken down by soil organisms, or which are broken down into by-products more toxic than the parent material, could result in future contamination of groundwater. The potential threat that these pollutants pose is dependent upon the quantity and type of the pollutants, the nature of the holding soil, and the location of the groundwater table. Highly permeable soils and a shallow groundwater table are conducive to groundwater contamination from persistent pollutants carried into the soil by stormwater.

During this study, little information could be located on the nature, extent, and control of nonpoint source pollutants, other than sediment, generated from construction activity. Basic research is needed in this area in order to more accurately assess the nature and extent of these pollutants and to develop definitive guidelines for their control.

The following information deals with the nature and control of various construction-related pollutants, other than sediment, within the confines of present state-of-the-art and common sense.

PESTICIDES

Insecticides, rodenticides, and herbicides are often used on construction sites to increase health and safety, maintain a pleasant environment, and reduce maintenance and fire hazards.[2] Oftentimes, rodents are attracted to construction sites requiring the use of dangerous rodenticides.

Insecticides most commonly used are the synthetic, relatively water insoluble chlorinated hydrocarbons (Aldrin, Benzene Hexachloride, Endrin, Heptachlor, Methoxychlor, and Toxaphene), organophosphorus compounds (Malathion, Parathion, Phosdrin, Diazinon, and TEPP), and Carbamates.

Rodenticides comprise a diverse group of chemicals (Thallium, Sodium Fluoracetate, and Warfarin) some of which may result in secondary poisoning to scavengers of the victim.[4]

Herbicides also comprise a group of diverse chemicals (Sodium Arsenite, Dinitro compounds, 2, 4-D, 2, 4, 5-T) useful in curbing poison ivy, and other noxious weeds and woody plants.

Clearance for use of many of these chemicals is often required by restrictive Federal, State, and local regulations. An awareness of the need to adhere to recommended dosages, type of application equipment, time of application, cleaning of application equipment, and safe disposal of these chemicals will go far in limiting the pollution of waterways. Application rates should conform to registered label directions. Disposal of excess pesticides, and pesticide-related wastes should conform to registered label directions for the disposal and storage of pesticides and pesticide containers set forth in applicable Federal, State, and local regulations. Recommended disposal and storage procedures have been promulgated recently by the Environmental Protection Agency.[6]

Pesticide storage areas on the construction site should be protected from the elements and from the curious. Warning signals should be placed in areas recently sprayed or treated with the most dangerous pesticides.[2] Persons involved in the mixing and application of these chemicals, to be in compliance with the law, must wear suitable protective clothing.

NUTRIENTS

Inorganic nutrient pollution results mostly from fertilizers used in revegetating graded areas. Incorporation of good soil stabilization measures, sediment control, and stormwater detention structures can be effective means of keeping these materials out of waterways. Small amounts of inorganic nutrients are beneficial to the productivity of waterways.[5]

Nutrient pollution can be minimized by working fertilizers and liming materials into the soil to depths of 4 to 6 inches, and by proper timing of the application. Hydroseeding operations in which the fertilizers and lime are applied to the ground surface in a one-step operation are more conducive to nutrient pollution than are conventional seedbed preparation operations where the fertilizers and lime are tilled into the soil. In the case of surface dressings, control can be achieved by applying the required quantity of fertilizer in more than one operation. For example, an area requiring an application of 1120 kg per hectare (1000 pounds per acre) of fertilizer could be dressed with about 280 kg. per hectare (250 pounds per acre) at four separate times.

Improper disposal of excess quantities of these materials can also be a major source of pollution. This can be avoided by preparing only the needed amounts and by using proper receptacles and procedures for their disposal.

SOLID WASTE

Solid waste is one of the major pollutants resulting from construction. Solid waste is generated from trees and shrubs removed during land clearing and during the installation of structures. Other wastes include wood and paper from packaging and building materials, scrap metals, sanitary wastes, rubber, plastic and glass pieces, masonry products, and others. Food containers such as beverage cans, coffee cups, lunch wrapping paper and plastics, cigarette packets, leftover food, and aluminum foil contribute a substantial amount of solid waste at the construction site.

The major control mechanism for these pollutants is to provide adequate disposal facilities. Collected solid waste should be removed and disposed of at authorized disposal areas.
The frequency of garbage removal helps maintain the construction

sites in a clean and attractive manner. Any useful material should be salvaged and recycled. For instance, masonry waste could be used for filling borrow pits; trees and brush from land clearing operations could be converted into woodchips through mechanical chippers and then used as mulch on graded areas. Selective removal of trees is helpful in conservation of soil and reduction of wood wastes. Indiscriminate removal of trees and other beneficial vegetation should be avoided at all cost.

Soil erosion and sediment control structures capture much of the solid waste from construction sites. Constant removal of litter from these structures also reduces the amount of solid waste despoiling the landscape. The extension of local and State antilitter ordinances to cover construction sites is also a viable control mechanism. Adherence to these regulations by construction personnel reduces unnecessary littering through carelessness and negligence.

CONSTRUCTION CHEMICALS

Several types of chemicals are used during construction activities. These chemical pollutants include paints, acids for cleaning masonry surfaces, cleaning solvents, asphalt products, soil additives used for stabilization and other purposes, concrete curing compounds, and many others. These materials are carried by sediment and runoff from the construction site.

A large percentage of these pollutants can be effectively controlled through implementation of soil erosion and sediment control practices. By using only the recommended amounts of these materials and applying them in a proper manner, pollution can be further reduced. As in the case of other pollutants, good housekeeping is also an important means of controlling pollution. This includes proper disposal of empty containers, prompt cleanup of accidental spills, neutralization and deactivation of excess chemicals and wash water.

PETROLEUM PRODUCTS

Petroleum products are widely used during construction activities. They are used as fuels and lubricants for vehicular operations, power tools, and general equipment maintenance. These pollutants include oils, fuels such as gasoline, diesel oil, kerosene, lubricating oils, and grease. Most of these pollutants adhere to soil particles and other surfaces easily. This is why some oils are used for dust control on unpaved roadways and construction sites.

One of the best modes of control is to retain sediments containing oil on the construction site. Soil erosion and sediment control practices can effectively accomplish this. Improved maintenance and safe storage facilities will reduce their chances of contaminating construction sites. One of the greatest concerns confronting users of these petroleum products is the method for waste disposal. Oil and oily wastes such as crankcase oil, cans, rags, and paper dropped in oils and lubricants can best be disposed of in proper receptacles. The dumping of these wastes in sewers and other drainage channels should be avoided at all costs to prevent contamination of streams and ponds. A further source of these pollutants is leaky vehicles. Proper maintenance of equipment and installation of proper stream crossings will further reduce pollution of water by these sources. Too many stream crossings can be avoided through proper planning of access roads.

OTHER POLLUTANTS

Other pollutants include concrete wash from concrete mixers, acid and alkaline solutions from exposed soil or rock units high in acid, and alkaline-forming natural elements. Cuts through coal beds have resulted in the seepage of mine acids into streams. High lime areas often increase the alkalinity of receiving waters.

The control of these pollutants involves good site planning and preconstruction geological surveys. Neutralization of these pollutants often provides the best treatment. Sealing of fractures in the bedrock with grout and bentonite will reduce the amount of acid or alkaline seepage from excavations. Adequate treatment and disposal of concrete further reduces pollution.

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VIII. STORMWATER MANAGEMENT

OVERVIEW

Both stormwater management, as it relates to the control of waterway erosion and subsequent sediment pollution, and stormwater drainage pertain to the removal of runoff. Stormwater management regulates the release of this runoff, by means of temporary storage or retardation of flow in order to reduce channel degradation and water pollution. Stormwater drainage, on the other hand, is a means of conveying the runoff in an efficient and economical manner to a point where it can be safely discharged. Unfortunately, the distinction between the two has been unrecognized by many in the field of water resources, largely because of the lack of clear understanding of the objectives of each.

Stormwater drainage systems are often designed to rapidly and effectively remove stormwater to a discharge point below the area of impact. This involves either the direct release of stormwater into the stream channel or to an underground collection system which, in many highly urbanized areas, involves the mixing of stormwater and sanitary wastes. During rain events, water that is released rapidly into the stream generally has sufficient velocity and volume to erode the stream and subsequently increase sediment deposition downstream. Rapid release of runoff into a combined sewer system can, depending on a number of factors, cause an overflow of mixed stormwater and sanitary wastes. This overflow is often diverted directly into urban streams without prior treatment, resulting in accelerated release of pollutants.

Stormwater management is a method of effectively controlling runoff, reducing stream channel erosion and sedimentation, and the release of pollutants resulting from the overflow of stormwater and other wastes. This is accomplished by temporarily storing and regulating the release of runoff from small magnitude storms. By controlling this runoff, nearly all of the stormwater will eventually reach the stream, but over a longer interval of time. This detention involves not only regulating the amount of water to be released, but providing a reduction in velocity of the runoff. Both of these factors must be considered in erosion and sediment control.

Stormwater runoff also affects water supply development. The development of water supplies is concerned with both the quantity and quality of water required to meet the needs of man. Stormwater drainage pertains to the quantity of water but not the quality of water. Neither of these factors can be neglected, because usefulness of the available water supply is determined in large part by the quality. Stormwater management involves both the quantity and quality of runoff. Although it is unable to combat all the problems related to water quality, it can minimize many adverse effects associated with urban development.

Although the need for controlling runoff during construction activity has gained a degree of recognition, that of controlling excess runoff after development has not been fully recognized. Construction of paved areas and buildings lowers the water storage capacity of the soil. This, in turn, leads to increased water runoff. Creation of impervious areas and the alteration of topography after development markedly decreases the utilization of this storage capacity and greatly diminishes the overall infiltration rate thus creating a greater volume of runoff (Fig. VIII-1). In the case of stormwater entering directly into a stream, these changes in the flow regimen cause accelerated erosion in the stream channel. Where this runoff enters existing sewer systems, capacity of the system may not be adequate to transport or treat this increased flow.

The effect of an increase in rate of flow on an area during and after development, can be illustrated by a case study. For simplicity, a hypothetical study area is used having simulated characteristics and conditions in the watershed. These assumed conditions

FIGURE VIII-1 Runoff from an impervious parking lot

are as follows:

(1) The watershed contains 100 acres.

(2) During the early development phase, the watershed was largely farmland with few roads. Imperviousness due to this limited development is 0.1-meaning that 10 percent of the area is impervious.

(3) After the watershed underwent extensive construction activity, new housing and the reduction of infiltration rates due to "surface sealing" increased the imperviousness to 0.25.

(4) After development was completed, multi-unit housing and extensive paved areas increased the watershed imperviousness to 0.6. All stormwater runoff was released directly to the stream channels.

(5) The area, during each stage of development, has undergone an identical rain event having a storm return interval of five years, and a storm duration of 30 minutes that yields 5.08 centimeters (2 inches) of rainfall.

Basic hydrologic data on rate, peak flow, and volume of runoff may be expressed in terms of characteristics of the unit hydrograph. The hydrograph, (Fig. VIII-2)of the given storm shows the percentage of total storm runoff occurring in each successive unit of time for three stages of development: pre-development, during development, and after development.

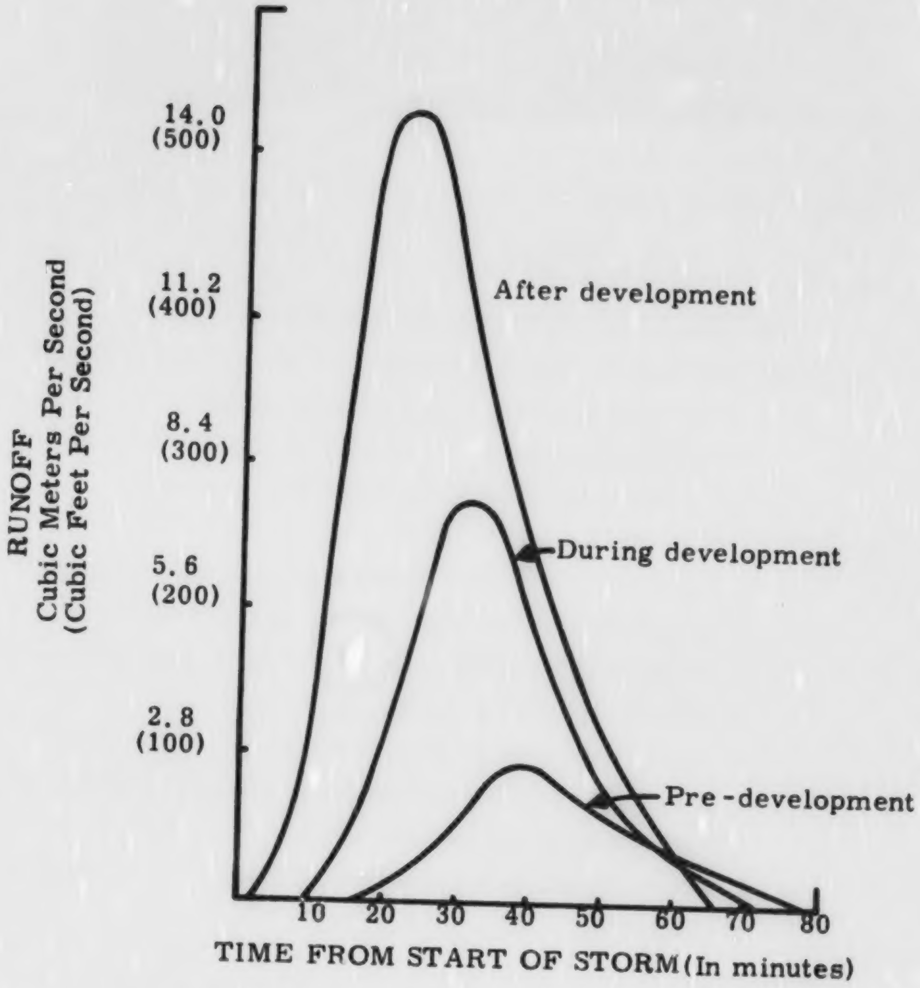

FIGURE VIII-2 Hydrographs of study area showing various stages of development

Interpretation of these hydrologic characteristics and its anticipated effects on the watershed are as follows:

(1) Pre-Development - Streamflow at the lowest point in the watershed could expect to reach 2.52 cubic meter per second (90 cubic feet per second) just after the end of the 30 minute storm. The area under the curve depicts the volume of runoff from the storm and is calculated to be 3,220 cubic meters (115,000 cubic feet). Erosion would be restricted to isolated areas with inadequate vegetative protection and limited stream channel erosion.

(2) During Development - With an increase in imperviousness to 0.25, the same watershed would, based on previous studies [2] yield a peak flow of 7.56 m^3 per second (270 cubic feet per second) and 10,660 cubic meters (345,000 cubic feet) of runoff. This increase in impervious areas has resulted in a 200 percent increase in runoff from the pre-development phase. Due to considerable area being unstabilized, the extensive runoff severely erodes the exposed areas. With no means of controlling the runoff, much of the sediment resulting from the erosion is transported to the stream. As conditions permit, the sediment is eventually deposited where it may be subject to additional movement during a later rain event.

(3) Post-Development - The watershed, now extensively urbanized, has an impervious area of 0.6. Peak flow at the out-point in the watershed is 15.4 cubic meters per second (550 cubic feet per second) for the given storm with the calculated volume of runoff being 18,984 cubic meters (678,000 cubic feet). This increase is 490 percent more runoff than the pre-development phase and 290 percent more than when the basin was undergoing construction.

After development, the tremendously increased runoff quickly passes into the stream channel. Erosion has been minimal in the recently stabilized upland areas. However, the increased runoff now erodes the stream channel and begins to undercut the banks causing collapse into the stream (Fig. VIII-3). The sediment generated in the waterway, some of which was originally deposited during construction activity, is now vulnerable to further transportation and eventual deposition further downstream. This is also true of other pollutants deposited with the sediment from the development.

With the channel now severely eroded, public pressure is exerted to correct the problem. The responsible agency may then pave the bank and bottom of the stream only to further accelerate channel flow and destroy the aesthetics of the stream (Fig. VIII-4). Such an "improved" channel only compounds the erosion and sediment problems further downstream. A highly desirable alternative to this type of storm drainage practice is a program of stormwater management. This would involve the use of practices that detain the runoff temporarily and thus maintain the maximum rate of discharge at the level that existed prior to development (Fig. VIII-5).

Although this particular case may be hypothetical, the problem of increased runoff from development and subsequent pollution does exist. There are many case histories of once natural streams becoming severely eroded because of construction activity in their watersheds.[3] By using a technique that would detain the runoff temporarily, the degree of discharge, as seen in (Fig. VIII-6) can be effectively maintained in a range that existed prior to the development.

FIGURE VIII-3 Collapsed streambank caused by undercutting

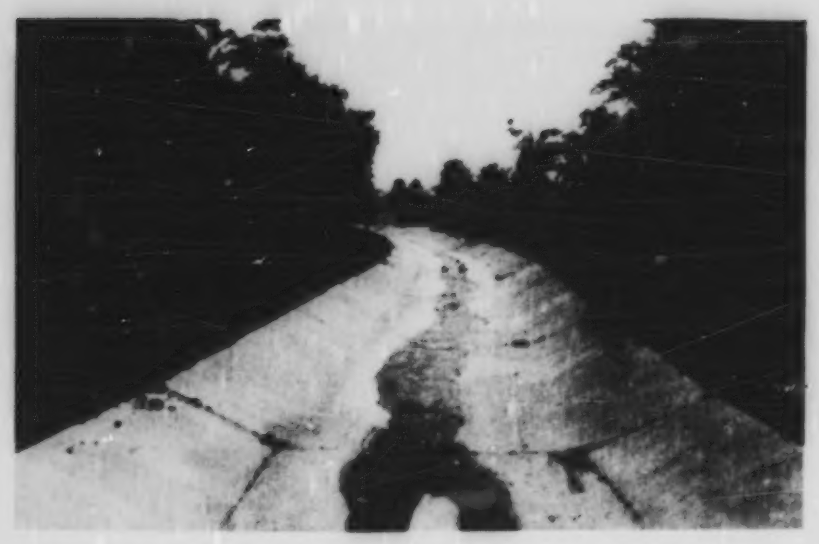

FIGURE VIII-4 Concrete-lined channel

FIGURE VIII-5 Stormwater management in stream channel

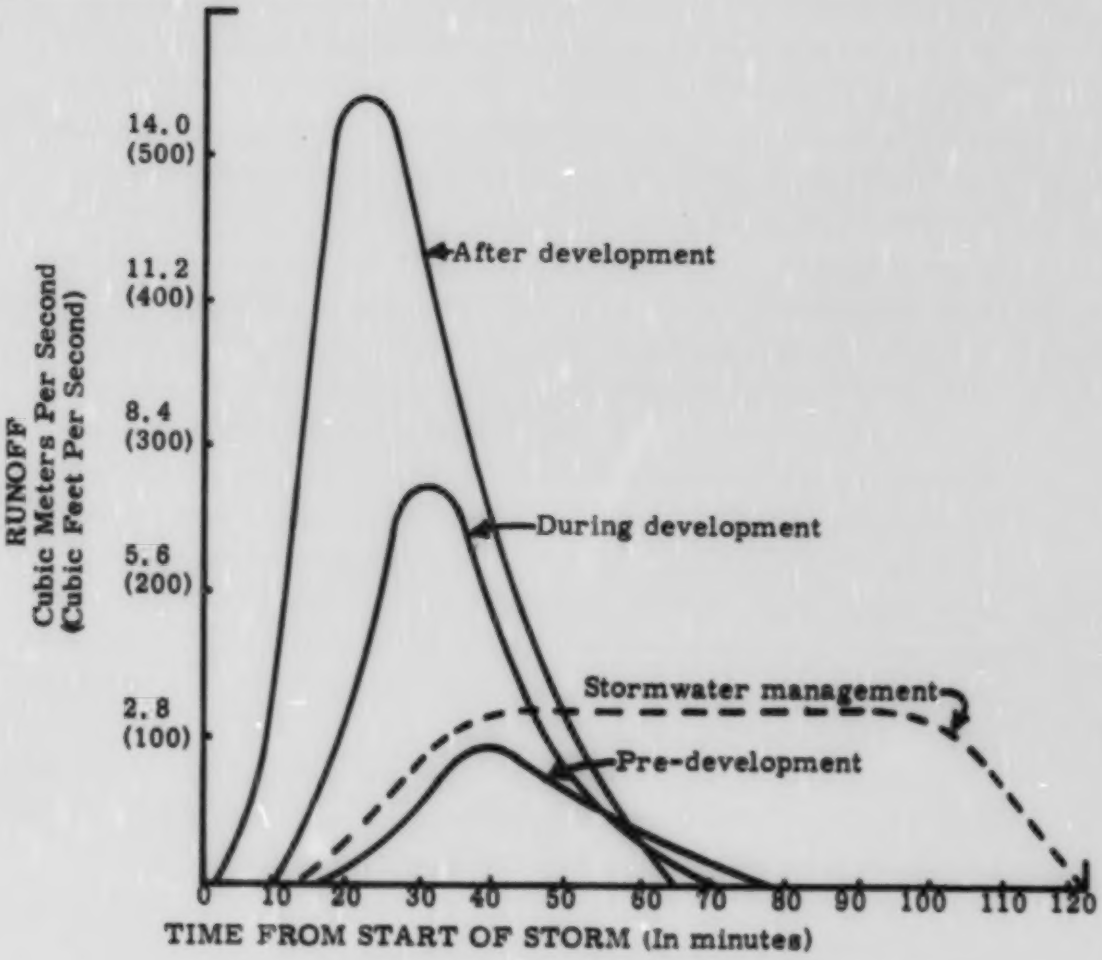

FIGURE VIII-6 Unit hydrograph (dashed-line) showing stormwater management applied to study area

The prevention of excessive erosion and sedimentation on a construction site is not the total solution to the problem of pollution from sediment and other associated pollutants. The excessive runoff generated by the construction will cause stream channel erosion below the site. Such erosion will start at the beginning of construction and will continue unabated after all construction is complete unless stormwater management techniques are imposed.

To be effective, the stormwater management program must be included in the site plan and implemented at the beginning of the first phase of construction activity. The first techniques to be employed may be temporary in nature and may serve a dual purpose. This would be the case with a temporary sediment basin that both detains runoff and traps sediment. In many cases the basin could be a permanent structure, designed for the control of stormwater and sediment during the construction period, and as a stormwater management structure after development is complete. The dual function of all erosion and sediment control practices must be recognized and fully exploited if optimum savings are to be realized in the implementation of the stormwater management program. This points up the need for one pollution control program that incorporates erosion control, sediment control, other pollutants control, and stormwater management.

A secondary benefit of stormwater management that must not be overlooked is flood control. In that the purpose of stormwater management is the attenuation of the peak flow in the stream, it does contribute to the control of minor flooding. In some areas, it may be desirable, from a cost standpoint, to upgrade the control techniques so that significant flooding protection is also achieved. These considerations must be made on a site by site basis.

METHODS OF CONTROL

The following list is a compilation of many of the existing stormwater management techniques. The effectiveness of each technique will depend on the physical characteristics of the development site as well as climatic factors. No one technique is applicable for all sites.

Most of the techniques are pervious. Thus during temporary storage some water will percolate into the soil and replenish the ground water supply. In semi-arid regions where water supply is sometimes scarce, many of these techniques could be used as a source of water by applying relatively inexpensive sealants to reduce water penetration. All of the techniques can be effective means of preventing excessive stream flows, but only if they are designed, installed, and maintained correctly.

(1) Roof Top Ponding - Stormwater may be temporarily stored on a flat or slightly sloping roof equipped with detention drains (Fig. VIII-7).[4] These drainage outlets are designed to release approximately 1.3 centimeters (1/2 inch) of water an hour. When rainfall intensity exceeds this rate, ponding occurs. To prevent excessive loading due to ponding, the outlets are equipped with overflows.

In many cases, existing buildings are readily designed to carry the load which will be imposed by rooftop ponding. Because of favorable economic factors, serious consideration for this method of storage should be given to industrial and commercial areas. Other benefits to be derived from this technique could be water supply for cooling, fire prevention, washing, etc.

(2) Parking Lot Ponding - Considerable area in urban development is occupied by parking lots. If planned correctly, these paved areas can provide adequate detention with minimum inconvenience to the public without interfering with the function of the lot (Fig. VIII-8), particularly in temperate climates.

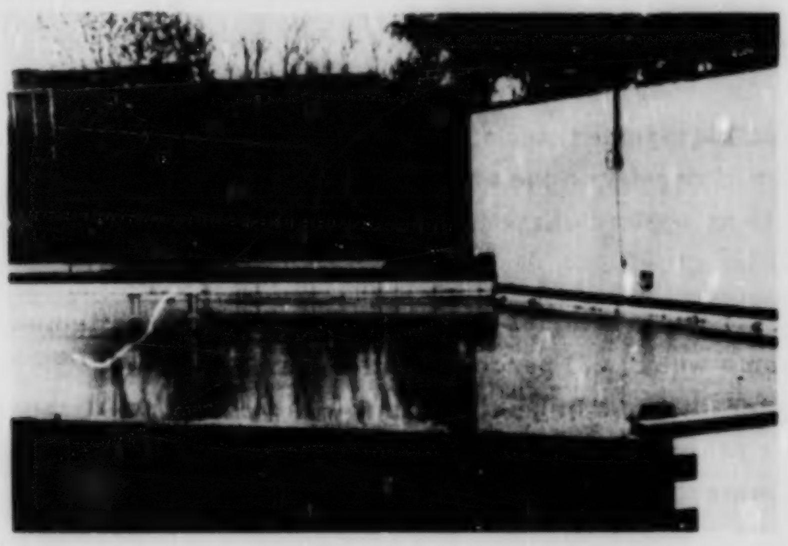

FIGURE VIII-7 Rooftop ponding

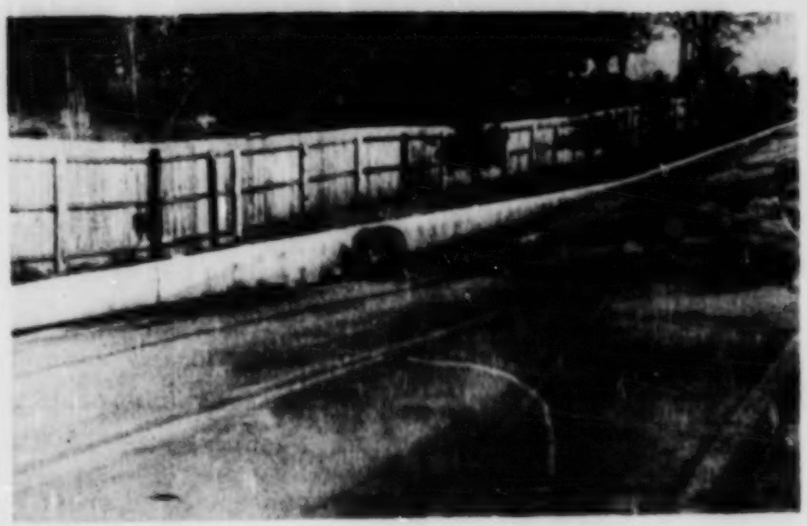

FIGURE VIII-8 Stormwater detention structure in remote portion of a parking lot

Temporary storage on parking lots is usually accomplished by reducing the size of the stormdrain inlet or by increasing the spacing between the inlets at remote areas of the parking lot. If properly planned, this method of control will cause a minimum of inconvenience on retail properties.

(3) Local Recreational Areas - Recreational areas can be used for temporary storage of runoff from adjacent areas. [5] Because of the substantial area of grass cover, these areas generally have high infiltration rates. Since these areas are not used during periods of precipitation, ponding of short duration should not seriously impede the primary use of the areas. To minimize aftereffects, the recreation area should be designed so that it will thoroughly drain. In addition, the grasses used on the area should be tolerant of periodic inundation and wetness (Fig. VIII-9).

(4) Diversion Structures - Diversion structures represent any modification of the surface that intercepts and diverts runoff in such a pattern that the distance of flow to a larger channel system is increased. These can be in the form of a ditch (or swale), dike, or terrace (Fig. VIII-10). Generally, a ditch or dike can be used in an area of moderate to high relief. These techniques have been used to a great extent along highways as a means of diverting runoff. They can be also used in urban developments, but not without adequate analysis of the geology and soils in the area. In areas where the potential for slumping and landsliding exists an alternate approach should be taken.

(5) Aeration of Lawns - Periodic perforation of lawns can be used to increase infiltration. This practice has been used on golf courses as a means of increasing infiltration and aeration on fairways for a number of years (Fig. VIII-11).

FIGURE VIII-9 Playground designed for temporary storage of runoff

FIGURE VIII-10 A diversion structure adjacent to highway

FIGURE VIII-11 Perforated lawn to increase infiltration

In a study of the effect of urbanization on rates of infiltration, urban lawns were found to have a very low infiltration rate in comparison to woodland and natural grasslands. This can be largely attributed to the high density of soil from "mixing" and compaction associated with construction activity and the heavy human use after development. Methods of increasing this infiltration, such as periodic aeration of lawns, as well as the practice of tilling prior to seed or sod application are excellent means of increasing the storage capacity of the soils.

(6) Ponds - Small permanent ponds installed with provisions for stormwater storage not only have the capability of attenuating peak flows, but also enhancing the urban environment as well (Fig. VIII-12). This "blue-green" concept may prove to be very practical in the open space plan, and should be seriously considered by developers of large tracts of land.[6]

FIGURE VIII-12 "Blue-green" concept in the urban area

Consideration, however, should be given to the quality of the runoff that is diverted to a small waterbody. Highly polluted waters can quickly change the ecological balance in the ponds. Regardless of water quality, designs should include an outlet so the ponds can be drained when maintenance is required.

(7) Detention Basin - Detention basins (or dry ponds) are permanent structures, which store the peak runoff and release this storage at a controlled rate through an outlet. When the volume of water exceeds the storage capacity of the basin, the excess runoff will pass the system through an emergency spillway located on the edge of the basin. The basins are designed so that they slowly empty dry after the storm. They can be both effective and aesthetically acceptable provided there is adequate space allocation,and they are correctly designed, constructed, and maintained (Fig. VIII-13). In many cases where these measures are not taken, the basin area is unsafe and unaesthetical (Fig. VIII-14).

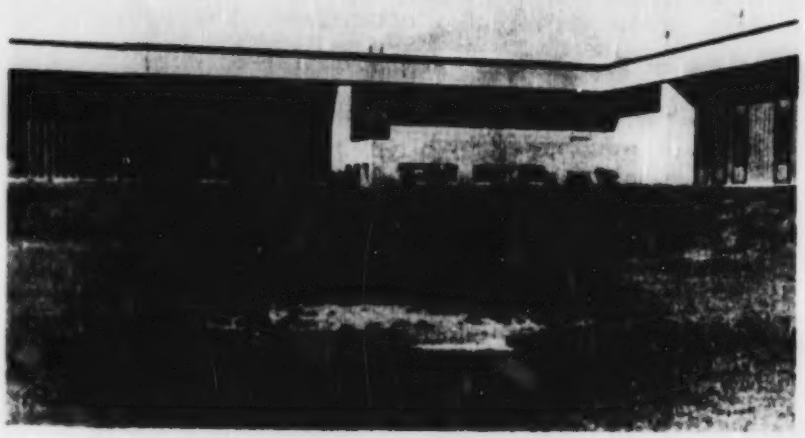

FIGURE VIII-13 An aesthetical and functional detention basin blending in with character of landscape

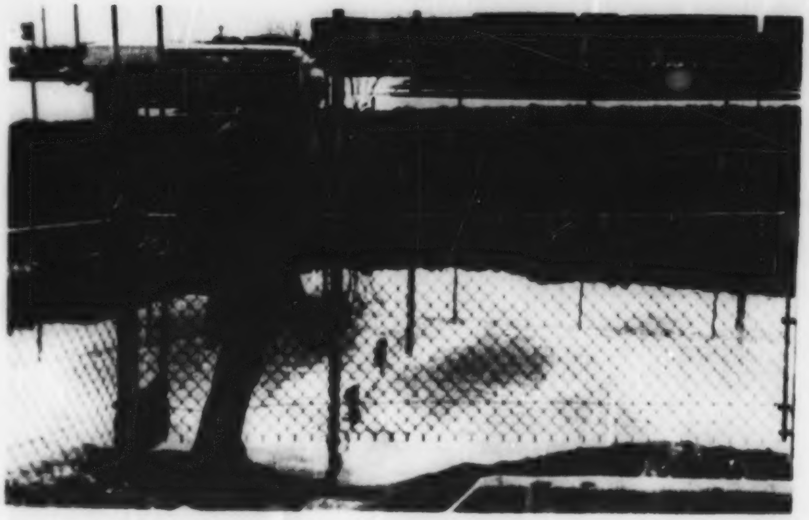

FIGURE VIII-14 Poorly constructed and maintained detention basin

(8) Porous Pavement - Porous pavement is a surface that will allow water to penetrate through it and percolate into the soil.[7] At present, porous asphalt pavement appears to have the most merit. This pavement is comprised of irregular shaped crushed rock that is precoated with an asphalt binder. The water seeps through this aggregate into a lower layer of ordinary gravel for temporary storage and then filters naturally into the soil. Considerable applied research will be necessary prior to any wide-scale use of this technique.

(9) Holding Tanks - Holding tanks are primarily used as a means of detaining runoff from a parking lot or roof top. They are normally located underground and are made either of metal or concrete. In most cases, tanks have a controlled release device which removes the water and subsequently drains the tank after cessation of the storm to an underground sewer or open channel. In some cases, this runoff is stored to be used as a source of water supply at the site.

(10) Infiltration Systems - Infiltration systems have been used for a number of years as a means of controlling runoff along highways. More recently, they have been adopted as a means of managing stormwater in urban developments. They consist of holes excavated into the ground and filled with coarse, clean stone or lined with brick or concrete block provided with perforations (Fig. VIII-15). These structures store stormwater and allow it to percolate into the soil. The slowly percolating water replenishes groundwater supplies, and in turn increases stream flows, through seepage, during low flow periods.

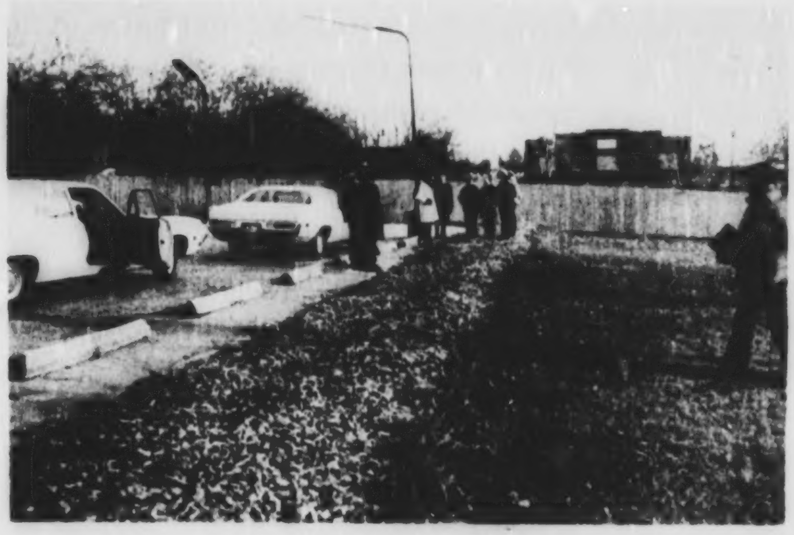

FIGURE VIII-15 Infiltration system collecting runoff from parking lot

The applicability of this technique will depend largely on the type of soils and topography at the site as well as the location of the groundwater table. A relatively pervious subsoil is necessary in order to dispose of the water at an adequate rate. The location of the groundwater table will limit the depth of the system. Infiltration systems are recommended for sites where limited detention capacity is required. However, in judging the suitability of this type of control, other factors should also be taken into consideration. One factor is the quality of the stormwater. Since little is known about the probability of groundwater contamination, only the better quality stormwater should be disposed of in this manner and adequate clearance must be maintained between the bottom of the structure and the groundwater table. Maintenance is another factor, especially when crushed stone or gravel is being used. To avoid clogging and very expensive repair work, traps should be provided to remove sediment and other debris from the runoff before it enters the infiltration area.

(11) Stream Channel Storage and Control - Stream channel storage and control is any type of detention or retardation of flow which involves the use of the stream channel or the stream channel and its floodplain, as a means of attenuating peak rates of runoff. The methods used are subdivided into the following groups: in-channel, side-channel, and off-channel.

In-channel storage and control can be achieved by altering the channel, either by channel relocations or by the use of small structures solely within the stream channel. By accentuating a meandering stream, for example, the distance of flow is increased and the velocity reduced. To achieve the degree of stream channel stability needed in the case of channel modification, banks generally need to be stabilized with rip-rap, stone-filled gabions, concrete or asphalt (Fig. VIII-16).

In-channel structures, such as check dams or weirs, reduce or prevent excessive erosion by reducing the velocities of flow in water courses. If spaced at regular intervals throughout the channel, they may appreciably reduce the overall peak flow from the watershed.

Side-channel storage involves the use of side channels that run essentially parrallel to the main stream channel and temporarily store water during excess rain events. These structures temporarily detain water at periods of high runoff and release it at a controlled rate.

Off-channel storage is the utilization of the stream channel and its flood plain for storage by installing an embankment across the channel system (Fig. VIII-17). This embankment may be designed to create either a permanent impoundment during all flow conditions or a temporary storage impoundment during excessive runoff events (Fig. VIII-18). In the case of a permanent body of water, the design must include space for storage of stormwater during peak flow periods. After cessation of the peak flow, the water level will again return to the level existing before the storm. In the latter case, during excessive runoff events, water will rise in the pond and be released at a controlled rate through an outlet device. Regardless of which technique is used, an emergency spillway must be constructed to pass flows that exceed the design capacity of the structure. The dual use of channel-floodplain areas for stormwater detention and recreational use has merit in many instances, especially in urbanizing areas.

FIGURE VIII-16 FABRIFORM® check dam

FIGURE VIII-17 Permanent lake with available capacity to detain excess runoff

FIGURE VIII-18 Temporary storage impoundment along roadway (Courtesy of the U. S. Dept. of Agric.)

(12) In-Line Storage in Sewers - In-line storage to control runoff can be accomplished by essentially two methods.[9] These involve either increasing the total capacity of a sewer system or maximizing the storage capacity of an existing system by instrumental controls. The first method involves the expansion of the system by installation of tunnels, storage tanks, holding basins, or a combination of these structures at some point between the major inflow and outflow of the system.[10-12] In maximizing storage of an existing system, use is made of sewer regulating structures that can increase the capacity of the system by restricting the flow.

(13) Others - There are additional means of managing stormwater, which will undoubtedly be applied as stormwater management achieves a degree of momentum. These techniques include many common sense practices that can, as a rule, be applied to construction sites. For example, they may include the adoption of site grading patterns that will increase flow distances; the use of trees not only for aesthetic purposes or as noise buffers, but also for intercepting rainfall, and, the elimination of curbing along secondary roadways to permit the spreading of water over the shoulders.

WATERSHED PLANNING

Stormwater management in a watershed can be obtained by using an areal, or a linear system of control, or a combination of both. The use of the systems, regardless of the type, requires the allocation of space at certain points in the watershed and this space allotment must be made in the planning phase of watershed development.

The areal system of control involves (Fig. VIII-19) the use of an integrated set of techniques in which each technique controls only a very small percentage of the watershed. In this system, the techniques are somewhat varied, because their use is largely determined by the type and extent of development. Individual sites may use such methods as rooftop and parking lot storage, infiltration systems, and diversion structures. Sub-areas of the watershed may use such techniques as localized permanent ponds capable of detaining portions of the stormwater runoff. The area of control for each technique is small but if designed and installed properly, the entire watershed can be controlled effectively.

Stormwater management by the linear system of control would involve (Fig. VIII-20) controlling stormwater at strategic points in the watershed. Accordingly, these structures would normally have a greater capacity than those used in areal control. They would be installed either in or near the stream channel to utilize the channel and its floodplain as a place of storage, or installed within the sewer system.

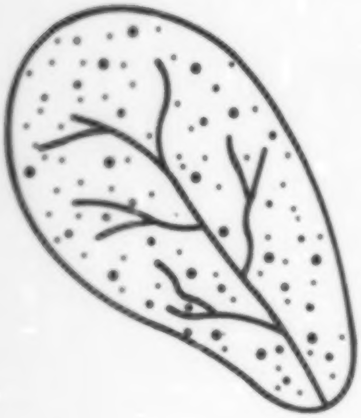

FIGURE VIII-19 Areal system of control

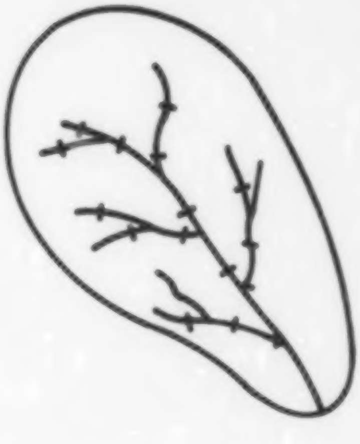

FIGURE VIII-20 Linear system of control

Neither system of control nor any combination can be isolated as a more effective method. The system used and the techniques used within the system will have to be determined for each watershed, and will depend on the physical characteristics, and the type and extent of proposed development in the watershed.

The best approach to stormwater management is by good land planning and the utilization of multi-purpose facilities to detain runoff. This involves the use of existing structures, the modification of these structures for multi-purpose use, or creation of new structures. The multi-use techniques may vary from the use of a flat roof to the use of a permanent recreational lake for temporary storage.

The major benefits to be realized from stormwater management are reduction of water pollution, mainly from sediment, and severe aesthetic and ecologic damage to the natural waterways. Other aesthetic, ecological, and cost benefits will be derived as well. These include savings on downstream drainage system costs, reduction of flooding in higher value downstream areas, and, in some areas, increase in property values.

The maximum effectiveness of stormwater management can be achieved only by controlling runoff on the entire watershed. In partially developed watersheds where stormwater management has not been applied, the approach appears to be one of maintaining conditions that already exist in the stream channel. This can be done by implementing stormwater control on the remainder of the watershed to be developed. However, the major benefits will come from the rural watershed that will be developed with an integrated system of stormwater management techniques.

DESIGN

The problems associated with urban drainage prompt an increasing need for research in the field of Urban Hydrology. Although there is progress towards reducing the problems, the basic evaluation and design techniques for stormwater management practices need improvement. [13]

Design for stormwater management involves two additional factors that are not considered in storm drainage. These are the determination of detention volume and maximum release rate. The maximum release rate is usually set as the release rate of a specified frequency storm that occurred prior to development. In other words, if there were identical storms before and after development, the maximum release rate from the detention structure would be equivalent to the rate of runoff that occurred before development. The volume to be stored is thus a function of this difference in release rate between the pre-and post-development storms. The design methods presently being used to determine these factors are the rational method, [14] the unit hydrograph, [15] and various rainfall-runoff simulation models. [16-20]

Research presently being conducted is not adequate to determine which is the most effective storm return frequency to be considered in the design of various techniques. Most areas adopting stormwater management use the 5 or 10 year return frequency rainfall as a basis for design. This is largely because the technique is based on the design of the existing storm drainage system and not on the effectiveness of reducing channel erosion.

MAINTENANCE

Periodic maintenance will be required to insure the operating efficiency of each technique (Fig. VIII-21). Adequate provision for this should be considered in the planning and design stage of development. The type and frequency of maintenance will depend largely on the technique used and the quality of the incoming water. Maintenance not only involves the periodic removal of accumulated sediment and debris, but may also involve periodic applications of chemical and physical treatments. This is especially true of vegetated structures where regular fertilization will be necessary to maintain a strong, healthy vegetative stand. A permanent body of water requiring periodic chemical treatments to reduce algal growth is another example. In time, some techniques may need to be reconstructed or modified to maintain or increase their efficiency. Regardless of the technique used, maintenance will be necessary and the frequency of this maintenance can be determined only by regular inspection.

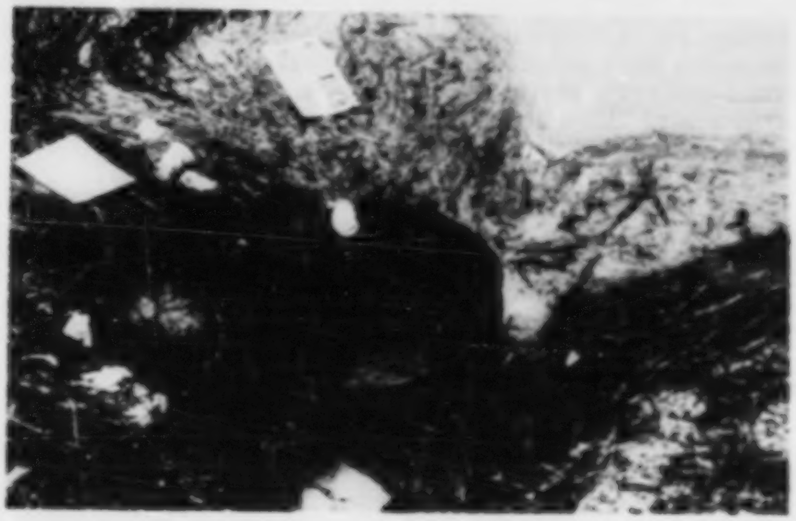

FIGURE VIII-21 Outlet of a detention basin in need of maintenance

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IX. INSTITUTIONAL PROCESSES AND PROCEDURES RELATIVE TO THE CONTROL OF POLLUTANTS RELEASED DURING CONSTRUCTION

OVERVIEW

Previous sections of this report deal with the technical aspects of the control of pollution resulting from construction activity. Institutional procedures for dealing with this problem represent a complex domain in which political, socioeconomic, technical, and scientific issues interact in a matrix which includes all the other factors associated with affluence and urbanization in our post-industrial society. Specifically, erosion, sedimentation, and other pollutant control programs involve the exercise by political and other institutions of certain options concerning various programs dealing with land use, land use planning, construction activities, areawide drainage programs, and the zoning process.

During the last 25 years, many towns and villages situated in proximity to burgeoning metropolitan areas have witnessed rapid changes in land use patterns. The accelerated clearing, grading, and construction work taking place on these landscapes relates directly to increases in the numbers and affluence of people. New roads, buildings, shopping centers, reservoirs, power lines, and other facilities are required to meet the needs of increasing numbers of people. Oftentimes, serious stormwater runoff, accelerated erosion, sedimentation, and other pollution problems are generated when heavy rain and wind storms sweep across exposed soils of various construction sites. The magnitude of this problem will depend on such factors as topography, climate, soil erodibility, and the nature of the construction activity. Control of pollutants released during construction, however, should be viewed as a part of broader land use and watershed management programs.

Experiences of homeowners and public officials in the urban Boise Front area of Ada County, Idaho,[1] and in suburban Montgomery County, Maryland[2] during the late fifties and early sixties provide representative examples of this problem. For example, the 1959 and 1965 floods in the urban Boise Front area left tons of sediment and debris on roads and in home basements.[1] Many thousands of dollars were spent cleaning up the flood debris. The Boise Front problem arose in part from changed land use patterns in which residential developments began to encroach upwards on previously undisturbed hillsides and, in part, from traffic from motorcyclists along the steep slopes. After holding a series of meetings with various public and private officials relative to development problems, the Ada County Development Council, with assistance from the Ada Soil and Water Conservation District, formulated a "Hillside Development Technical Guide" designed to control erosion and sediment on the Boise Front. The Ada Council of Governments has developed interim criteria to be used in formulating a "Hillside Development Ordinance."[1]

In Montgomery County, Maryland, property owners were also troubled during the early sixties by flooding and sediment deposition at already urbanized downstream sites resulting from the conversion of upstream areas from agricultural to urban and suburban uses.[2] After several challenges in the courts from several property owners, the Montgomery County Council adopted a sediment control resolution in June 1965 in recognition of the problem. Next, the County Council appointed a sediment control task force consisting of representatives from the land developers, home builders, zoning and planning officials, sewer and water officials, and technicians from the Montgomery Soil and Water Conservation District, among others, to develop a countywide sediment control program. Two years later, the Council made sedimentation control mandatory during construction by adoption of an amendment to the County's subdivision regulations. Cooperation of the building industry was actively cultivated throughout the entire period.[2]

In both of these examples, the sediment and runoff control program directly affected land use, construction, and zoning policies with direct benefits to water quality. Procedures used in this effort involved political, administrative, technical, and scientific skills and issues. The stimulus to organized action in both examples came at the local level and was triggered by accelerated erosion and flooding resulting from land clearing, grading, and development of lands previously undisturbed, or used for grazing and the intensive production of food and fiber crops. On the assumption that the urbanization process will be with us for some time, it would appear the better part of wisdom for communities and agencies presently at the threshold of development to begin now the task of working out suitable strategies for coping with nonpoint sources of construction-related pollution.

On January 1, 1970, with the adoption of the National Environmental Policy Act (NEPA) of 1969, [3] there was a broadened commitment to the protection of the environment. [4] In evaluating the impacts of Federal actions on the environment an interdisciplinary approach is essential, and is encouraged by NEPA. This move was backed up with the creation of a Council on Environmental Quality reporting directly to the President. [3] Federal agencies responded to NEPA and related environmental directives by developing in-house policies to implement the law. Criteria have been prepared to permit decisions on which major Federal actions significantly affect environmental quality. Procedures for consultation and coordination with Federal, State, local, and individual interests relative to the planning, design, construction, and operation of Federal projects are still evolving.

The 1972 amendments to the Federal Water Pollution Control Act apply to navigable waters and fresh water lakes, groundwater, territorial seas, and, for some wastes, ocean waters out to 10 miles. [5] The new "Water Bill" seeks to achieve use of the best practicable pollution control technology by 1977, the best available technology by 1983, and a nationwide "no pollution discharge" by 1985.

Variants of NEPA have already been adopted by eight States and more are expected to follow.[6] State versions of NEPA have the potential for controlling land development and construction activities in the private sector by virtue of the constitutional authority granted to State and local governments to control land use.[6] California's Environmental Quality Act, for example, requires that county boards shall make environmental assessments before issuing building permits to private groups concerned with land development.[6]

State and local governments are in the crucial position of undertaking the complex task of overall resource management with all the attendant pressures from the market community. Ways must be found for reconciling the diverse objectives of economic and social opportunity, industrial growth, housing, transportation, recreation, farming, and so forth, with a higher quality of life.[2,6]

Presumably, solutions to the problem can come from a citizenry willing to assign higher values to environmental amenities and to work harder and pay more to obtain these amenities.[7] Beyond this, the overall political system should be capable of more rapidly and accurately translating changes in social values into governmental actions at local, State, and Federal levels. Finally, corporate leadership should strive to be more responsive to shifts in public priorities and government regulations pertaining to the environment.[7] Apparently, the reconciliation of traditional market motives with the diverse citizen concerns for an enhanced quality of community life can take place when: (1) rational siting and land use guidelines have been established, (2) State and regional planning groups can find a viable political base, and (3) the consequences of technology can be more systematically assessed.[6] If these goals are ever to be achieved, there must be strong, continuous, and complementary leadership within and between the several levels of the Federal, State, and local governments.

The purpose of this section is to examine the evolution and present status of several institutional processes and procedures for controlling nonpoint or areawide pollutants released during the clearing, grading, construction, and development of landscapes. Emphasis is placed on the fact that government programs required to deal with these problems are continually evolving.

EVOLUTION OF RELEVANT POLLUTION CONTROL LAWS AND DIRECTIVES

Federal Regulations and Actions

Pollutants released from construction sites and other nonpoint or area sources in rapidly urbanizing areas may enter the waterways of a given State or locality and act to lower the water quality, scour stream banks, and endanger aquatic flora and fauna.[8] In recognition of diverse threats to the quality of interstate waters, Congress has enacted the various water pollution control laws. The passage of the Federal Water Pollution Control Act (FWPCA) in 1948 is considered to have marked the beginning of the modern age of water quality legislation.[9] This law authorized Federal agencies to support research in water pollution and set up new projects on water treatment technology for a five-year period. Enforcement powers were given to State governors. The WPCA of 1953 extended the 1948 legislation for three more years. On July 9, 1956, the FWPCA called for increased cooperation between Federal and State agencies. Federal funds were provided to assist the States to prepare water pollution control plans and to build water treatment plants. This legislation appears to have fallen short of what was actually needed, namely, putting the responsibility for administering the FWPCA in the hands of cabinet level officials.[9] An amendment to the FWPCA made in 1961 required this step. Responsibility for administering FWPCA was placed in the U.S. Department of Health, Education, and Welfare (HEW). For the first time, a Federal structure was available to coordinate the Act. The 1961 amendments extended Federal jurisdiction to abate both interstate and intrastate pollution of navigable waters.[2] In 1965, the Water

Quality Act placed all Federal water pollution control programs under a new agency called the Federal Water Pollution Control Administration and required all States to enact water quality standards by June 30, 1967, that would enhance the quality of interstate navigable waters. These standards were to be accompanied by a plan for their implementation and enforcement.[2] Both Federal and State water quality standards suggested that turbidity (mainly sediment) was a pollutant wherever it interfered with the beneficial uses of any State waters. Maryland and Wisconsin have led all other States in declaring sediment to be a pollutant.[2,10]

In 1966, through authority of the Water Quality Act of 1965, the President issued Executive Order 11258[11] requiring all Federal departments to review Federal and federally-aided projects relative to water pollution by sediment. This action was particularly relevant for sediments and other pollutants arising from the construction of primary and secondary highways.

Certain limitations inherent in the approach to sediment control engendered by the 1965 Act refer to the setting of standard limits to water pollution, determining when these limits have been exceeded, and trying offenders in public hearings. More direct and simple control procedures have evolved at State and local levels such as preventing or minimizing erosion, runoff, and sedimentation from specific construction sites through the requirement that all development and construction plans be submitted along with a complete erosion and sediment control plan fitted to each construction site.[12]

Following the adoption of NEPA,[3] the President issued Executive Order 11507 dated February 4, 1970,[13] requiring that the Federal government should provide leadership in the design, operation, and maintenance of its facilities in a manner consistent with the national effort to protect and enhance air and water quality. Also, Federal agencies were required to complete or have underway measures needed to assure compliance with applicable air and water pollution control standards by December 31, 1972. All new facilities were required to be designed and constructed so as to protect and enhance the quality of the environment.

On March 5, 1970, Executive Order 11514[14] required, among other things, that Federal agencies monitor, evaluate, and control on a continuing basis their activities so as to protect and enhance the quality of the environment.

On April 23, 1971, the Council on Environmental Quality (CEQ) issued specific guidelines[15] covering the preparation and coordination of environmental impact statements. The following actions require the preparation of environmental impact statements by all Federal agencies:

(1) agency recommendations relative to their own proposals for legislation, including agency reports on legislation originating elsewhere
(2) Federal agency projects and continuing activities supported wholly or in part through Federal contracts, grants, loans, or involving a Federal lease, permit, license, or other entitlement for use
(3) policy, regulations, and procedure-making

The environmental statement should cover the following items:

(1) data adequate to permit assessment by commenting agencies
(2) probable impact of proposed action on the environment
(3) probable adverse, unavoidable environmental effects
(4) alternatives to the proposed action
(5) assessment of cumulative and long-term effects
(6) irreversible or irretrievable commitments of resources
(7) request comments from the Environmental Protection

Agency relative to water quality aspects of the
proposed action

On May 13, 1971, the President issued Executive Order 11593[16] requiring that the Federal government shall, among other things, initiate measures needed to direct policies, plans, and programs in such a way that federally-owned sites and structures of historical, architectural, or archaelogical significance be preserved, restored, and maintained for the cultural benefit of the people.

During an International Environmental Conference on Building and Construction and Use[17] sponsored by the General Services Administration (GSA), a "Building Construction Panel" (along with other panels on socioeconomic factors, site selection, design, and use) was convened to consider ways of lessening environmental contamination during construction. The following needs were highlighted:

(1) "practical solutions to problems of water runoff from construction sites"

(2) "staging and time of construction to reduce period during which construction occurs"

(3) " ways of preventing dust storms resulting from excavation and grading operations"

(4) "specific methods of handling and disposal of construction debris"

(5) "reduction of off-site negative effects of construction including loss of business and increase in crime"

Consideration was also given to environmental standards for Federal construction contracts relative to the adequacy of contract provisions, existing regulations, and incentives.[17] The construction panel submitted the following recommendations for erosion control during federal construction:

(1) Responsibility should be exercised jointly by the architect-engineer (AE) and the contractor.

(2) The AE should prepare site grading and drainage drawings.

(3) The requirements of EPA's report on "Control of Erosion and Sediment Deposition from Construction of Highways and Land Development" of September 1971[18] should be incorporated into construction documents.[19]

Other aspects of recent Federal environmental directives refer to the need to provide timely and accessible information to the public about present and future plans having an environmental effect. Several Federal agencies, such as the Soil Conservation Service (SCS) have long standing mandates to assist public and private institutions, organizations, and individuals in improving the quality of man's environment. For example, the SCS policy in providing technical assistance involves the following:

(1) using a systematic interdisciplinary approach to environmental problems

(2) taking account of social, economic, biological, physical, and other factors that affect the environment

(3) using SCS resources in ways that contribute fully to the prudent use of natural resources

State and Local Regulations and Actions

Accelerated population growth and the activities of highly motivated land developers resulted in the rapid development of the former agricultural uplands watershed of the Sligo Creek area of east-central Montgomery County, Maryland during the late 1950's.[20] In connection with this, large areas of highly erodible soils were exposed for relatively long periods of time and the extent of paved-over areas was increased sharply. These and other conditions were conducive to serious flood and sediment damages in already urbanized areas downstream from these highly developed upstream areas from time to time during high intensity rainstorms. Actions of planning agencies to acquire and control high flood risk stream valley lands were thwarted by the market interests.[20] As a result, the upland watershed area of the Sligo Creek area of east-central Montgomery County was completely developed to homes and businesses producing, in the minds of many people, what has been termed "disastrous results."

An irate, but knowledgeable citizenry, coupled with sympathetic public officials brought forth new fruit in a newly conceived federal assistance program known as the "Small Watershed Act" (PL-566, 83 Congress, 2nd Session).[21] In 1957, funds from this Act were authorized for use by the Maryland National Capital Park and Planning Commission (MNCPPC) to plan two multiple purpose flood prevention and recreation impoundments in the Upper Rock Creek Watershed in Montgomery County.[22] Local sponsors were the Montgomery Soil and Water Conservation District, the Montgomery County Council, and the MNCPPC. Five years later (in 1962) plans for this watershed were completed. In 1963, the Upper Rock Creek Watershed was authorized for operations and in the fall of 1964 one of the flood retention structures was completed. Hard upon the completion of this structure was the successful bid of land subdividers to obtain higher building densities and several rezonings in the affected areas.[22]

At this point in time (1964), the Montgomery County Council was advised by the State Conservationist of the Soil Conservation Service that PL-566 funds for construction of the second flood retention structure could not be made available until the Council stated its zoning and erosion control enforcement intentions in the watershed above both dams.[22]

Exercising its constitutional authority to assume responsibility for this problem, the Council appointed a sediment control task force consisting of land developers and the building industry: the bicounty agency responsible for the administration of zoning and subdivision regulations, the Montgomery Soil Conservation District representatives, the bicounty agency responsible for providing sewer and water facilities, and representatives from interested state and federal agencies.[20] Two important related legal aspects of this sequence of events were: (1) In 1961, the Attorney General for the State of Maryland had established an opinion recognizing sediment as a pollutant and therefore subject to regulation by the Maryland Department of Water Resources,[10] and (2) The so-called "Bulldozer Law" passed in 1961 by the state legislature gave Montgomery County added authority to control land development.[22]

The sediment control task force developed a voluntary sediment control program and presented it to the Council in the spring of 1965. On June 29, 1965, the County Council adopted the program and county department heads were given the responsibility for developing in-house policies and procedures to carry out the program.[2] After two years' trial with voluntary compliance, the Council decided to make sediment control mandatory during private construction activities by amending Section 104-24 of the "Subdivision Regulations for the Maryland-Washington Regional District within Montgomery County."[2] The Montgomery Soil and Water Conservation District was designated as responsible for approving sediment control measures on construction sites. The County Department of Public Works was given the responsibility of enforcement.

After the first full year of operation of the mandatory sediment control program (in 1968), it became apparent to the evaluation team that the technical principles of erosion and sediment control were not understood clearly by the community. As a result, steps were taken by the county to promote better understanding and awareness of the erosion and sediment control program. Another important aspect of this evolving program was that the evaluation team in 1968, and again in 1970, consisted of representatives from the Maryland National Capital Park and Planning Commission (zoning and subdivision regulations), the Department of Public Works (enforcement of sediment controls), the Suburban Maryland Home Builders Association (both builders and engineers), and the Soil Conservation Service (technical inputs from state and federal levels).[20]

The Montgomery County, Maryland experience illustrates well the role of a local government in assuming the responsibility, and assigning funds to carry out an important pollution control program. At least five organizational steps are recognizable, and these are considered to be of prime importance for local governments having an interest in starting similar programs:[2]

(1) The need for erosion and sediment controls was formally recognized by local elected officials.

(2) Administrative and legal controls were formulated.

(3) Specific responsibilities were assigned to local agencies.

(4) On-site inspection and maintenance of control efforts were provided for.

(5) The program was evaluated by a representative group of interested persons at several time intervals.

A second example of local legislation applicable to the control of erosion, sedimentation, and other pollutants released during construction is seen in the "Erosion Control Ordinance" of 1967, Fairfax County, Virginia.[2] This ordinance was written directly into the Fairfax County Code containing previous requirements of importance to developers. Briefly, the ordinance states:

(1) That a construction permit will not be issued, or construction plans approved unless the developer's plans meet ordinance requirements.

(2) A soil conservation plan must be submitted by the developer, who in turn is required to guarantee by cash escrow that the approved soil conservation plan will be carried out.

(3) Inspectors from the Department of County Development evaluate compliance of developers with the approved plan.

(4) In case the developer fails to comply, his cash escrow can be used by the county to carry out necessary conservation practices. In which case the developer would be forced to increase the cash escrow.

Returning to the Montgomery County, Maryland experience, history is clear in showing that leadership exerted in that area quickly spread to other rapidly urbanizing areas in Prince Georges, Baltimore, Howard, and Anne Arundel Counties. All of these adopted sediment control programs using the task force approach initiated through the Soil and Water Conservation Districts and other aspects of the Montgomery experience during the period 1967-1969.[22] Concomitantly, the Maryland National Capital Park and Planning Commission (MNCPPC) drafted erosion and sediment control legislation for the Patuxent River Watershed area completely within the State of Maryland.[22] The MNCPPC legislation was introduced as House Bill No. 1298 during the 1969 session of the General Assembly and this was enacted as Chapter 415 of Maryland Laws, effective July 1, 1969. This law was designed to control pollution of the Patuxent River, establish standards for sewage treatment plants, and called for sediment control plans for any earth changes, except for agricultural practices and on single family residences of 0.81 or more hectares (2 or more acres).[20, 22] The soil conservation districts were assigned responsibility for approval of site development plans, and all counties were encouraged to use the task force approach to develop programs and procedures to carry out the new law. The Soil Conservation Service (United States Department of Agriculture) assisted with, consolidated, and updated the standards and specifications for erosion and sediment control in urbanizing areas. These standards were made available to the Soil Conservation Districts and to other interested persons.

In December 1969, six months after passage of the Patuxent River Watershed Law (Chapter 415 of Maryland Laws) the Prince George's delegation to the General Assembly drafted legislation to extend the Patuxent Law to the entire state of Maryland.[22] The Maryland Sediment Control Law was enacted as Chapter 245 of the Acts of 1970 on the first Earth Day, April 22, 1970.[22] This law gave statewide leadership to the Department of Natural Resources, taking the traditional authority for State water pollution control away from the State Health Department, and removing the piecemeal approach to water quality. For the first time, statewide leadership provided for a degree of uniformity of regulations and procedures between county and State agencies.[20]

Rules and regulations adopted on April 4, 1972 by the Maryland State Department of Natural Resources concerning sediment control[23] state clearly that the Secretary shall "adopt criteria and procedures to be used by the counties, municipalities, and the local soil conservation districts to implement soil and shore erosion control programs." In addition, the Department will assist the soil conservation districts to prepare a unified sediment control program and assist the counties in the development of grading and building ordinances for sediment control.[23] The Maryland Sediment Control Law can be described as a prevention-oriented program requiring approved sediment control plans prior to the commencement of land clearing, grading or disturbance.[23]

At the present time, the State of Maryland is organized into five regions, each equipped to deal with water quality problems arising within its boundaries. In addition, the marine police and all other statewide inspectors have been coordinated in a way permitting close cooperation between and within each of the regions.[24] New and innovative approaches are being sought constantly. For example, a new court ruling states that any local ordinance stronger than the statewide law takes precedence over State law, thereby opening the way for local jurisdictions to adopt much stronger land development regulations, if deemed necessary.[24]

The Maryland experience has been discussed at length because it stands as a reference standard by which environmental actions, taken by knowledgeable leaders in a rapidly urbanizing community, resulted in the adoption by the county of workable plans for minimizing erosion, sedimentation, and other forms or causes of pollution during construction activities. The task force approach used by Montgomery County was repeated successfully in neighboring counties undergoing rapid urbanization. Undergirding these actions was the strong support from the local Soil Conservation Districts and the Soil Conservation Service technical staffs.

In turn, strong leadership from the bicounty commission (MNCPPC) responsible for zoning and subdivision regulations led to the drafting of erosion and sediment control legislation covering the Patuxent River Watershed of more than 223,000 hectares(550,000A.)

Strong leadership was equally evident on the part of the State legislators instrumental in securing the adoption of the Patuxent Watershed Law. Within 10 months, this Watershed Law served as the point of departure for the adoption of a statewide sediment control law. Such rapid progress could not have been achieved without due recognition by the Governor and a majority of other legislators that this law was needed.

Administrative responsibility for the Maryland Sediment Law was placed in a new Department of Natural Resources which, for the first time, provided for better coordination, greater uniformity of procedures, greater cooperation, and increased dialogue within and between county and state groups.

An important aspect of the Maryland Sediment Law is that it is a prevention-oriented program. Land developers and others are required to exert greater effort in adapting their plans to ongoing efforts by the state to improve water quality and protect environmentally valuable areas to the maximum extent by retaining soil in place throughout the watersheds of the State. However, there are certain items which the Maryland State Department of Natural Resources has found critical and which other states and jurisdictions ought to consider.[25]

(1) "Proper clarification of fundamental relationships between the coordination of State law requirements (exemptions, standards, and administration) and the local grading ordinances."

(2) "Adequate staffing and funding for local sediment control inspection activities. Cost sharing between the State and counties for sediment control inspectors has been suggested on many occasions."

(3) "Authorizing funds for additional soil conservation district personnel."

(4) "Adequate staffing at the State level to implement a statewide program. The Department has found that reviewing, approving, and inspecting all state projects, and assisting local jurisdictions in developing programs are indeed time-consuming tasks."

COORDINATION OF PLANS AND CONTROLS

Federal Agencies

Provisions for Federal funding and technical assistance to States and local jurisdictions relative to water quality were included in the Federal Water Pollution Control Act Amendments of 1972.[5] An important document illustrating the need for more effective future coordination of construction plans (and presumably environmental controls) between Federal, State, and local governments was issued on February 9, 1971, by the Executive Office of Management and Budget (OMB).[26] Known as revised Circular A-95, this document contained a mandate for added cooperation between all levels of government in the evaluation, review, and coordination of and federally assisted programs and projects, in furtherance of section 204 of the Demonstration Cities and Metropolitan Development Act of 1966 (DCMDA), Title IV of the Intergovernmental Cooperation Act of 1968 (IGCA), and section 102 (2) (C) of NEPA, 1969. For example, section 204 of DCMDA requires that applications for Federal assistance to highway and other construction projects should be accompanied by the comments of an areawide comprehensive planning agency as to the relationship of the proposed project to the planned development of a given area. Section 410 (C) of IGCA states that all Federal aid for development purposes should be consistent with the objectives of State, regional, and local planning groups. In essence, the OMB urges the creation of opportunities for contact and communication within and between the several levels of governments. This step would appear to be a necessary precondition for the coordination of Federal development projects.[26]

Interagency cooperation during the initial phases of project planning can lead to more substantial environmental benefits and economies. Obvious benefits include forehand knowledge of existing facilities and future plans, and compatibility of design relative to land use, storm sewer systems, and highway construction, among others.[27]

Economies can be realized through carefully worked out joint or multiple funding projects.[17,27]

On February 27, 1970, the President issued Executive Order 11512 directing the General Services Administration to amend its established procedures for planning, locating, acquiring, building, and managing Federal installations in urban areas.[17] Recognition was given in this document to the socioeconomic as well as the environmental impacts of Federal construction activities. Federal buildings appear to have been located in the past in urban areas such as to essentially ignore the social programs, plans, and economic needs of these local areas. Selective placement of any Federal facility can be a vehicle for achieving the objectives of local community development plans.[17] Criteria should be developed and applied for the avoidance of chronic hazardous pollution areas and the protection of present and future environmentally valuable areas such as wetlands, ground water recharge areas, wildlife areas, scenic, historical, and archeological sites in all of the states.[17]

The degree of coordination between Federal agencies and the various state and local groups relative to construction and development activity varies in relation to the authority of each group. Public institutions are frequently compartmentalized by design - a situation which essentially guarantees the lack of easy communication within and between units, and the fragmentation of the decision making process.[28]

An important exception to this condition is seen in the procedures for coordinating interrelated work areas, worked out between the Nevada Highway Department (NHD) and the Nevada office of the U.S. Department of Interior's Bureau of Land Management (BLM) at both the district and State office levels (Appendix D, Section V). These procedures were developed in consultation with key persons at various levels in each organization, and culminated in a memorandum of understanding between the two groups.

In brief, each organization stated its primary input into once a year local and State coordination meetings with emphasis on:

(1) Local meetings

  (a) to exchange data on storm events and surface runoff in 12 representative basins, and on peak flows in areas near existing and proposed new highway systems

  (b) to review plans and arrange simultaneous scheduling and execution of work programs

  (c) to identify unresolved problems requiring attention at the next level of management

  (d) to work out mutually beneficial exchanges of manpower, materials, and equipment on the basis of specific case interrelated work areas

(2) State meetings

  (a) to develop procedures for coordinating BLM-NHD work on a statewide basis

  (b) to review priorities

  (c) to conduct joint evaluations and review of plans

  (d) to resolve conflicts

This cooperative work has been conducted for the last 10 years. In addition to data exchanges, both organizations advise each other on storm damage and emergency situations noted in the field by their respective field workers. The great value of this relationship is that each group obtains a clearer understanding of its responsibilities, thereby minimizing duplication of work.

Of necessity, the authority delegated to each Federal agency influences its major functions. For example, the Federal Power Commission excercises only regulatory functions over hydroelectric power plants and has no direct planning function for these. Other agencies may be totally involved in the construction of dams, reservoirs, nuclear power plants, powerlines, and access roads.

Federal agency participation in, and control of various construction activities can be illustrated partially in the following terms:

(1) Federal groups having authority to issue licenses and special permits

    (a) bridges and highways across navigable streams (Department of Transportation, Coast Guard)

    (b) Federal highways through federal lands (Agriculture's Forest Service; Interior's Bureau of Land Management)

    (c) hydroelectric power plants and power lines (Federal Power Commission)

    (d) nuclear power plants and associated powerlines (Atomic Energy Commission)

    (e) ski slopes and other recreation areas on Federal land (Agriculture's Forest Service)

    (f) pipelines across navigable streams (Corps of Engineers)

(2) financial and technical assistance from Federal groups

    (a) indirect participation through federally aided projects
    -primary highways (Department of Transportation, Federal Highway Administration)
    -urban housing (Housing and Urban Development)

(b) full participation in planning, funding, and construction
- dams and reservoirs (TVA, Army Corps of Engineers, Agriculture's SCS, and Interior's Bureau of Reclamation)
- military construction (Department of Defense's: Army, Navy, and Air Force)
- Federal Buildings (General Services Administration)

(c) evaluation of environmental impact statements for adequacy of nonpoint source pollution control.

Since the adoption of the National Environmental Policy Act in 1970 and the issuance of guidelines for environmental impact statements by the Council on Environmental Quality in April 1971, it is certain that there has been a large increase in the dialogue between Federal and Federal-State agencies relative to various construction activities. Other mandates beyond NEPA have already been discussed in the first paragraph of this section on "Federal Agencies." Furthermore, the language set forth in Sections 3(a) and (b) of the CEQ guidelines [15] requires Federal agencies to achieve consistency in following the administrative procedures set forth in Executive Orders, Office of Management and Budget directives, and the guidelines so as to "assure effective coordination among agencies in their review of proposed activities."

State and Local Groups

Because most sedimentation problems involve entire river systems or drainage basins and involve, in turn, Federal, State, and private lands, it is evident that reciprocity should exist between Federal agencies and the various organizations that represent State and local interests. [18] An integrated approach to erosion and sediment control can be achieved when all Federal, State, and local organizations within a drainage basin coordinate their control efforts. [18]

This is essential because the costs of major improvements such as dams, reservoirs, and open space lands are usually covered through intergovernmental multipurpose projects.[2] Local governments can take the initiative in generating workable sedimentation controls in relation to these major construction activities, however, if they have the legal authority to enter into intra- and inter-governmental agreements through memoranda of understanding, specific statutory provisions, formal agreements, or delegated statewide powers.[2]

Erosion and sediment control measures needed on housing developments, shopping centers, and similar types of construction activity can be funded by developers and contractors as a part of their normal construction duties. This procedure is now being followed, for example, in Fairfax County, Virginia, and in all counties of Maryland. Local governments can also finance various areawide water management measures through Federal and State assistance programs, taxes, and bond issues.[2] Normally, financial and technical assistance is not provided to local governments specifically for use on sediment control measures. Rather, assistance comes through programs in which sediment control is only one of several eligible activities.[2]

Local governments should make provisions for control of erosion and sediment in all private and public project plans relating to the following:

(1) highways, railroads, streets, and trails

(2) shopping centers, schools, parks, and airports

(3) housing developments

(4) industrial and commercial developments

(5) utilities, pipelines, power lines, and other underground installations

(6) dams, reservoirs, and waterways

(7) sanitary landfills and overland flow wastewater treatment systems

(8) sediment spoil areas

If there are no statewide or countywide laws pertaining to the control of sediment and other pollutants released during construction activities, state enabling legislation can provide legal authority to political subdivisions for regulating land disturbances in both the private and public sectors and for managing sediment and other pollutants in coordination with other water management programs through the following:[2]

(1) grading ordinances

(2) areawide stormwater management regulations

(3) land use planning regulations

(4) zoning regulations

(5) flood plain ordinances

(6) subdivision control laws

(7) sewerage regulations

(8) building codes relative to soil stability and subsurface and surface drainage patterns

In the unified national program of floodplain management underway since 1966, progress has been made toward ending the uneconomic, hazardous, and unnecessary use of land lying adjacent to rivers and flood-prone areas.[29] Cities and towns such as Hartford, Conn., Tulsa, Okla., and Atlanta, Ga., have already implemented flood plain controls.[29] A full range of flood plain related technical and planning services is available to Federal, State, and local governments who have enabling legislation, from the Corps of Engineers Flood Plain Management Services Program.[30] These services include advice on flood plain regulations, information on individual building sites and short reaches of stream and coast, and in some cases long reaches that have not been covered by Flood Plain Information Reports. These services are provided through the 47 Corps of Engineers Division and District Offices. Additional guides are provided by the Office of the

Chief of Engineers, U. S. Army.[30]

Local organizations to which responsibility can be assigned for coordinating certain aspects of sediment and pollution control include agencies such as flood control districts, soil conservation districts, irrigation districts, drainage districts, and sanitation districts.[2] However, these groups appear to possess two major drawbacks:

(1) Coordination with other governmental programs is not mandatory.

(2) By providing services not usually handled by an existing government agency, they tend to perpetuate themselves.

An exception to this generalization is seen in the flood districts in the State of California.[2] Leadership has been provided by these districts in coordinating federal flood control programs of the U. S. Army Corps of Engineers, and the Agriculture Department's Soil Conservation Service with State, county, city, and private agency programs.

Similarly, the more than 3000 soil and water conservation districts created under provisions of State law, provide useful service in that their programs have been expanded in urbanizing areas to provide help in solving suburban soil and water problems.[2] Many of these districts are related closely to county governments, either by law or by cooperative agreements. Certain districts have shown exceptional ability to coordinate their activities with programs in other jurisdictions. Broad-based representation on soil and water conservation commissions in certain States has been achieved through new legislation.[2] This is an important development for urbanizing areas.

Voluntary agencies composed of local governments such as the Metropolitan Washington Council of Governments (COG) have become important in promoting areawide coordination of sediment control efforts. For example, the Regional Sediment Control Advisory

Committee of COG was active in delineating the sediment control activities and needs in the Washington, D.C. area.[2] Assistance in promoting the coordination of intergovernmental programs can also be provided by most areawide planning agencies. These agencies may also be assigned the responsibility for carrying out public education programs.[2]

Whether or not there exists an areawide sediment control law, local elected officials desiring to develop effective environmental control programs may wish to take the following steps:

(1) Appoint a task force composed of persons connected with planning commissions, water and sewer agencies, soil conservation districts, home builders associations, professional engineers and architects, U.S. Soil Conservation Service, contractor's groups, private conservation groups, and citizen groups. This task force should accomplish the following:[2]

  (a) Ascertain the nature, extent, and effect of sediment and other pollutants on local and areawide water quality.

  (b) Identify existing land use, sediment, and other water pollutant control laws.

  (c) Identify sediment and other pollution control practices currently being used by developers, contractors, and Federal and State agencies.

  (d) Work out techniques for gaining the cooperation of developers, contractors, and public officials in carrying out the proposed program.

  (e) Locate sources of technical and financial assistance from Federal, State, and private sources.

- (f) Develop a program for informing the public about the need for comprehensive environmental controls.

(2) Make a decision on the extent and toughness of local controls in terms of local soil, topographic, geologic, and climatic factors. Additional points should be considered, as follows:[2]

- (a) Assign responsibility for administering controls to one or more groups already in existence.
- (b) Organize an evaluation team with broad-based political, technical, planning, and private representation to determine the effectiveness of the controls.
- (c) Provide for budgeting, planning and review, drafting and adoption of standards, enforcement, inspection, and overall operation of the system.
- (d) Prepare financial plans to cover immediate and long-range capital financing of controls for parks, reservoirs, and other public construction.
- (e) Provide techniques for handling citizen complaints.
- (f) Provide for in-house training of inspectors, maintenance personnel, planners, and others.

RECENT LEGISLATIVE APPROACHES

One further example of the task force approach to legislative action is seen in the recent cooperative efforts resulting from the First National Symposium on State Environmental Legislation held in Washington, D. C. in March, 1972 under the joint sponsorship of the Council on Environmental Quality, Council of State Governments, Environmental Protection Agency, and the Department of the Interior. In this symposium, the Soil Erosion and Sediment Control Workshop, which reflected participation by the foregoing agencies and the National Association of Conservation Districts, the U.S. Department of Agriculture's Soil Conservation Service and Office of General Counsel, and several States, appointed a committee to serve as a task force to draft specific provisions of a suggested State law on erosion and sediment control for submission to the Council of State Governments by May 1, 1972. The result of this committee's work is the "Model State Act for Soil Erosion and Sediment Control" (See Appendix E and Reference 31). This Act has been submitted to key State officials for consideration by State legislatures during 1973. EPA and NACD, under contract agreement, now are involved in conducting a series of State sediment control institutes to encourage the various states to develop legislation for uniform statewide sediment control laws.

As of August 20, 1973, the NACD has convened 17 sediment control institutes in Connecticut, Georgia, Hawaii, Idaho, Kansas, Kentucky, Louisiana, Minnesota, Montana, North Dakota, Oklahoma, Oregon, South Dakota, Tennessee, West Virginia, Wisconsin, and Wyoming. To date, 17 states (Georgia, Illinois, Iowa, Maryland, Minnesota, Montana, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Virginia, Virgin Islands, West Virginia, Wisconsin, and Wyoming) have drafted and introduced sediment control legislation. Since 1970, nine states (Iowa, Maryland, Michigan, North Carolina, Ohio, Pennsylvania, South Carolina, Virginia, and the Virgin Islands) have adopted sediment control legislation.[32]

Legislation in Wisconsin emerged as a model ordinance for use by soil conservation districts in adopting land use regulations for sediment, runoff, and erosion control in accordance with comprehensive plans developed pursuant to Section 92.08 of Wisconsin statutes.[33] The model ordinance applies to all lands lying outside the limits of incorporated areas. This action does not detract from the overall effectiveness of the Wisconsin legislation to control and prevent pollution from sediment and other pollutants released during construction acitivity, however, since soil and water related programs for incorporated areas would be contiguous to the overall planning done by the soil conservation districts.[33]

Whatever administrative course or legislative format is followed by a given State in its effort to deal with various aspects of pollution by sediments the following principles should be applied:

(1) The soil erosion and sediment control program should be applicable statewide to different types of land use and soil conditions.

(2) Soil areas having critical erosion and sediment control problems should be identified.

(3) Statewide guidelines including conservation standards for controlling erosion and sediment resulting from all types of land disturbing activities should be adopted.

(4) District or local control programs consistent with State programs and guidelines should be established.

(5) Certain land disturbing activities not conducted in accordance with approved soil erosion and sediment control plans should be prohibited. Special requirements would be applied to land disturbances typical of agricultural and forestry operations.

(6) Existing State and local regulatory mechanisms such as issuance of building, grading, and other permits, as applicable, should be used to implement the requirements of the erosion and sediment control plan.

(7) Inspection, monitoring, and reporting requirements should be applied, subject to modifications of approved plans by mutual agreement.

(8) Penalties, injunctions, and other enforcement strategies should be provided.

(9) Adequate funds should be provided to carry out the Act.

In its present form, the Model State Act omits controls pertaining to stormwater management, and pollutants other than sediment.

Since 1965 various county and State statutes have been enacted which, for the most part, require a permit for any earth moving activity.[31, 35] Issuance of a permit hinges upon approval of a plan submitted by the developer for controlling erosion and sedimentation. Approval powers reside in the local soil conservation district. Ordinances of this type have been adopted in Howard, Montgomery, and Washington counties in Maryland; Steele County in Minnesota; Fairfax County in Virginia; and Buffalo County in Wisconsin.[31, 35]

Four States, Iowa, Ohio, Illinois, and Wisconsin, have recently amended their soil conservation districts laws to provide for sediment control: Iowa requires conservation districts to establish and enforce "soil loss limits;" Ohio authorizes the Director of Natural Resources to coordinate agricultural pollution abatement and urban sediment control programs based on the State's water quality standards; Illinois requires its conservation districts to assist local zoning authorities in reviewing applications for proposed land subdivisions; Wisconsin broadened its regulatory authority through land use regulations to include the control of runoff and sedimentation and authorized county assistance in enforcing these regulations.[35]

Two States (Maryland in 1970 and South Carolina in 1972) and the Virgin Islands (in 1972) have adopted statutes authorizing local governments to require, by ordinance, sediment control plans that must first be approved by the soil conservation districts.[35]

Two States, Pennsylvania (in 1970) and Michigan (in 1973) have enacted laws unrelated to amendments to soil conservation district laws (Appendix E). For example, Pennsylvania's Clean Stream Law provides regulations to control accelerated erosion and sedimentation, with penalties and permits to protect streams from pollution. Michigan's Soil Erosion and Sediment Control Act provides for a statewide control program for enforcement by the county government and assistance from soil conservation districts.[35]

INSTITUTIONAL DECISION-MAKING PROCEDURES

Responsibility for policy decisions relative to the control of sediment and other pollutants resulting from construction activity and other nonpoint or area sources, should be assumed by local officials because it is doubtful if Congress would be willing to establish a Federal system of regulating construction-related sediment and runoff. [36] For example, legislation requiring exclusive Federal approval of an erosion and sediment control plan for each construction project would appear to be unrealistic, because monitoring and reporting systems comparable to those for point sources are not possible for nonpoint sources.[36] Yet, if State and local governments manage the system, "it is doubtful that Federal control can be meaningfully exercised through issuance of Federal standards", because valid general standards appear unattainable relative to construction-related pollution. [36]

Unquestionably, local officials have the constitutional authority to make decisions concerning the use and allocation of local land and water resources. Also, a sedimentation and pollution control program constitutes a segment of soil and water resource management which ought to be the responsibility of elected officials at the local level. [2]

Questions can be raised, however, concerning the efficacy of the decision-making process at the various levels of government. For example, local jurisdictions are beset from one side by the many lobbyists for interests other than conservation, land use, and the control of pollutants. From another side comes the environmental demands of individual citizens and organized interest groups having new "pieces of the truth." [6] Environmental "impacts and amenities which are unmeasurable or unquantifiable are nevertheless real and should be as integral to decision-making as quantifiable technical and economic considerations." [6]

This principle has been set forth clearly in the National Environmental Policy Act (NEPA) of 1969 which requires the development of environmental impact statements for new construction and other major actions by federal agencies.[3]

Citizen response to over 3000 impact statements during the past two years has ranged from consent without protest, to interference in agency affairs, to political demands, to extensive court action.[6]

Several agencies have responded to public opposition to new construction and other projects by using increased citizen participation during the program planning and design stages. This action goes beyond NEPA requirements that the final impact statement will be made available to interested citizens.[6] The practice of obtaining citizen feedback during the planning and design stages of construction projects avoids apparent deceptions inherent in the use of environmental impact statements when construction contracts are awarded. For example, it is evident that agencies can develop the impact assessment statement in order to justify the agency's statutory mandate.[6, 28]

Citizen involvement in the governmental and legislative process can be an important means of helping concerned legislators and officials to carry on background research, check on prior laws, and draft new legislation for protecting the environment.[28, 37]

Governments, through the use of taxes and legislation can encourage people to be more rational in making their personal decisions. For example, new legislation enacted in California (the Williamson Act) changed the practice whereby prime agricultural land such as citrus orchards located at the periphery of an urbanizing area was taxed as if it were being subdivided for a housing development. The new law gives concerned farmers in California a strong incentive to continue growing valuable food crops rather than selling out to land subdividers.[28]

Another way that governments can protect environmentally vulnerable areas is seen in the decision of citizens and officials of Baltimore County, Maryland not to permit the construction of impoundments and/or sewer lines in the valley floors of the Green Spring and Worthington Valleys. Also, intensive housing development was permitted only in the open plateau areas. These decisions were made and put into practice with the strong support, exercised mutually, between a majority of the residents, local planning groups, local agencies, and the State government.[37] The experiences of these and other groups illustrate that the workings of human initiatives, at all levels, can bring solutions to pressing environmental problems.

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SECTION X

APPENDICES PAGE

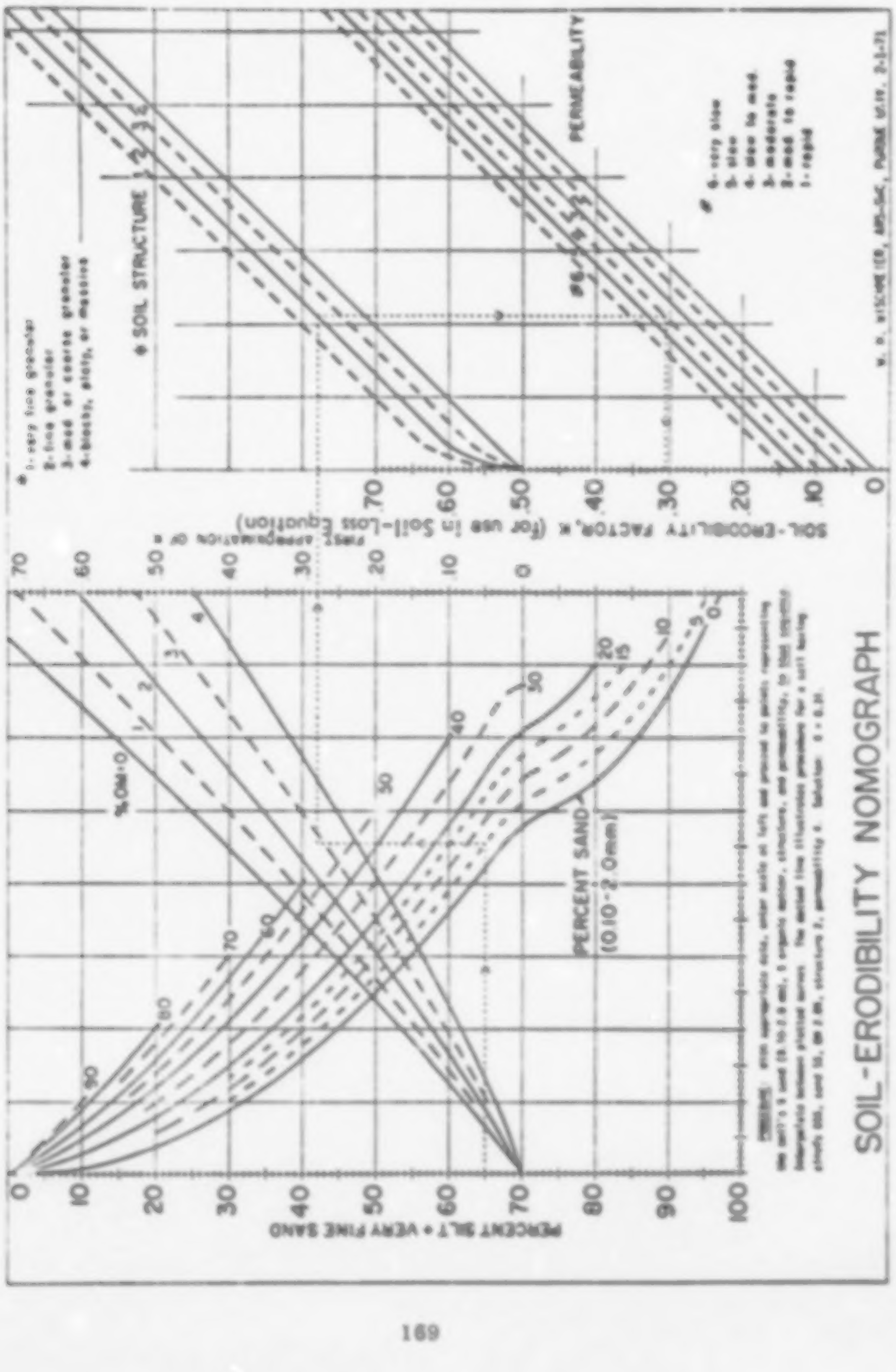
A. Soil-Erodibility Nomograph ---------------- 169

B. Special Notes Relative to the Water Pollution Abatement Plan ------------------------ 170

C. Approval and Certification Statements Relative to the Water Pollution Abatement Plan ---------------------------------- 171

D. Joint Memorandum Between U.S. Department of Interior and the State of Nevada---------------------------------- 173

E. Soil Erosion and Sediment Control Acts ---------------------------------- 181


SOIL-ERODIBILITY NOMOGRAPH
PERCENT SILT + VERY FINE SAND
0
10
20
30
40
50
60
70
80
90
100
PERCENT SAND (0.10-2.0mm)
%OM=0
1
2
3
4
0
5
10
15
20
30
40
50
60
70
80
90
SOIL-ERODIBILITY FACTOR, K (for use in Soil-Loss Equation)
FIRST APPROXIMATION OF K
0
10
20
30
40
50
60
70
.70
.60
.50
.40
.30
.20
.10
0
SOIL STRUCTURE
1
2
3
4
1- very fine granular
2- fine granular
3- med or coarse granular
4- blocky, platy, or massive
PERMEABILITY
6
5
4
3
2
1
6- very slow
5- slow
4- slow to med.
3- moderate
2- mod. to rapid
1- rapid

APPENDIX B

SPECIAL NOTES RELATIVE TO THE WATER POLLUTION ABATEMENT PLAN [27, 30] (see Section IV)

1. "No disturbed area will be denuded for more than __________ calendar days".

2. "All erosion and siltation control measures are to be placed prior to or as the first step in grading".

3. "All storm and sanitary sewer lines not in streets are to be mulched and seeded within 15 days after backfill. No more than 500 feet are to be open at any one time".

4. "Electric power, telephone, and gas supply trenches are to be compacted, seeded, and mulched within 15 days after backfill".

5. "All temporary earth berms, diversions, and silt dams are to be mulched and seeded for temporary vegetative cover within 10 days after grading."

6. "During construction all storm sewer inlets will be protected by silt traps".

7. "Any disturbed area not paved, sodded or built upon by 1 November is to be seeded on that date with oats, abruzzi rye, or equivalent and mulched with hay or straw mulch".

8. "Structural measures such as berms, dikes, traps, basins, etc., will be installed and stabilized according to this plan prior to any other grading, clearing, or disturbance of the existing surface of the site".

9. "All structural sediment control measures are to remain in place until permission for their removal has been obtained from the soil conservation district office authorized to approve this plan".

10. "Notify the soil conservation district office authorized to approve this plan at least 24 hours before starting any work."

APPENDIX C

APPROVAL AND CERTIFICATION STATEMENTS RELATIVE TO THE WATER POLLUTION ABATEMENT PLAN[30*]

BY THE APPROVING OFFICER:

THIS DEVELOPMENT PLAN IS APPROVED FOR WATER POLLUTION ABATEMENT BY THE JONES COUNTY SOIL CONSERVATION DISTRICT (OR OTHER APPROVING OFFICERS).

S/ Howard Baker (Approving Officer) June 12, 1973 (Date)

PLANNER CERTIFIES:

I CERTIFY THAT THE PLAN OF DEVELOPMENT AND THIS PLAN FOR WATER POLLUTION ABATEMENT HAS BEEN PREPARED IN ACCORDANCE WITH THE "STANDARDS AND SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL", AS ADOPTED BY THE JONES COUNTY SOIL CONSERVATION DISTRICT.

S/ James McClure (Planners Name) May 31, 1973 (Date)

DEVELOPER CERTIFIES:

I CERTIFY THAT ALL DEVELOPMENT AND/OR CONSTRUCTION WILL BE DONE ACCORDING TO THIS PLAN OF DEVELOPMENT, AND THE WATER POLLUTION ABATEMENT PLAN.

S/ John Smith (Name of Developer) June 12, 1973 (Date)

* See Section IV

APPROVAL OF TECHNICAL REQUIREMENTS:

THESE PLANS HAVE BEEN REVIEWED FOR (Name of S. C. D.) AND MEETS TECHNICAL REQUIREMENTS

S/ William Johnson
(Signature)
United States Department of
Agriculture Soil Conservation
Service

June 8, 1973
(Date)

APPENDIX D

JOINT MEMORANDUM BETWEEN

United States
Department of the Interior
Bureau of Land Management
Reno, Nevada

State of Nevada
Department of Highways
Carson City, Nevada

TO: All Nevada Personnel, Bureau of Land Management, Nevada - All Personnel, Department of Highways, Nevada

FROM: E. I. Rowland, State Director, Nevada
Grant Bastian, State Highway Engineer

SUBJECT: Procedures for Coordinating Interrelated Work Areas

I. PURPOSE

This memorandum outlines policies and procedures for use by Bureau of Land Management personnel, more particularly identified in Part III, for working with the Nevada Department of Highways and vice versa. It was developed by the Bureau of Land Management and Nevada Department of Highways in consultation with key employees at various levels in each organization. The memorandum is especially pointed toward:

A. Developing better understandings of responsibilities of the Bureau of Land Management and Nevada Department of Highways as it relates to work that is or may be interrelated;

B. Defining Bureau of Land Management and Nevada Department of Highways organizational lines, and delineating relationships to facilitate the coordination of such work;

C. Identifying interrelated work areas, developing procedures and standardized methods for coordination; and

D. Minimizing duplication of work.

It involves the coordination and integration of planning, programming and budgeting of such work in order to assure that joint efforts will bring about purposeful actions toward accomplishing Bureau of Land Management and Nevada Department of Highway goals and objectives. Such coordination is subject to the respective authorities of each agency. These authorities are highlighted in Part II hereof. This coordinated approach is designed to eliminate duplication, divergent plans, provide each agency sufficient lead time for proper sequential functions, make more efficient use of available resources, and moreover, develop and execute more responsive public action programs.

II. AUTHORITIES

The broad authority for such coordinated work is cited below. Regulations for the administration of such authorities are cited where necessary in part V. B. on each specific work area.

A. Bureau of Land Management

1. Legislation
    - a. Taylor Grazing Act of June 28, 1934, as amended
    - b. Federal Highway Acts of August 28, 1937, July 26, 1955; 1962
    - c. Recreation and Public Purposes Act of June 14, 1926
    - d. Right-of-Way Granting; Act of March 4, 1911; Act of February 25, 1920, as amended by Acts of August 21, 1935 and August 12, 1953
    - e. Materials Act of July 31, 1947
    - f. Antiquities Act of 1906
    - g. Historic Sites Act
    - h. Soil Conservation and Domestic Act of 1935
    - i. Halogeton Glomeratus Control Act of 1952
    - j. Water Pollution Control Act of July 9, 1956
    - k. Water Quality Act of 1965
    - l. Water Protection and Flood Prevention Act of 1954
    - m. Protection Act of 1922
    - n. Reciprocal Fire Protection Agreement Act of 1955
    - o. National Environmental Policy Act of 1969

B. Nevada Department of Highways

1. Legislation

   a. Nevada Revised Statutes; Chapters 37 et seq. and 408 et seq.
   b. United States Code, Title 23
   c. Code of Federal Regulations, Title 15, Title 25, Title 43 and Title 2700
   d. All applicable Federal Highway Acts - Concurrence of the Federal Highway Administration is required during various stages on all federally funded projects.
   e. Act of February 5, 1948; granting of right-of-way (Indian Lands)
   f. Act of March 4, 1911 (Radio Sites)
   g. Mineral Materials act of July 23, 1955
   h. Beautification Act of October 22, 1965
   i. National Environmental Policy Act of 1969 & Clean Air Act of 1970

III. ORGANIZATION AND WORK FLOW

A. Bureau of Land Management

1. The Bureau of Land Management operates under a line-staff organization. Bureau Order 701, as amended, provides specifics on Lands and Resource Delegations and Redelegations of authority among the different line levels of management in the Bureau of Land Management.

a. There are generally four levels of line management; i.e., Area Manager, District Manager, State Director, and Director.

b. There are also four levels of technical support for the aforementioned line managers. These are located in the district, State, two Service Centers, and Washington offices.

2. Bureau of Land Management district offices administering Nevada Public Lands are located in:

a. Elko, Winnemucca, Carson City, Ely, Las Vegas, and Battle Mountain, Nevada;

b. Susanville, California and Boise, Idaho. The District Manager in these offices administers Nevada public lands based on Memoranda of Understanding signed by the State Directors. Procedures developed herein apply to all public lands in Nevada.

3. The Bureau of Land Management's customary internal work flow is from the Area Manager to District Manager. District Manager to State Director, and State Director to Director. Generally, on external intergovernmental working relationships, the Area Manager, District Manager and their staffs work with local counterparts; the State Director and his staff with State and regional offices; the Director with regional and national office levels.

B. The Nevada Department of Highways operates through a line and staff organization.

1. In general, there are five levels of line authority: State Highway Board of Directors; State Highway Engineer; Deputy State Highway Engineer; Asst. Deputy State Highway Engineer; and division or district engineer.

2. Providing administrative support and technical assistance at each level of line authority are staff positions. These staff organizations are located and provide service within the Department headquarters structure and at the local district level.

3. District offices responsible for local administration of the highway program are located in:

a. Las Vegas (District One)
b. Sparks (District Two)
c. Elko (District Three)
d. East Ely (District Four)
e. Tonopah (District Five)
f. Winnemucca (District Six)

C. Internal work flow normally proceeds in either of two ways.

1. An activity originates at the district level through some local request, then proceeds from the district engineer to the asst. deputy, or to the deputy, and to the highway engineer.

2. An activity originates at the highway engineer level through some request from outside the agency, then proceeds to a deputy or an asst. deputy and to the appropriate division or district engineer.

3. Work requests that originate at the district level also frequently are referred to divisions within headquarters by either an asst. deputy or deputy highway engineer.

D. External work flow, normally involving relationships with other governmental entities and agencies, provides for direct working contact between: (1) division or district personnel and their local counterparts; (2) the deputies and asst. deputies, and assistant agency and department heads; and the State highway engineer and agency directors at the State and regional levels.

E. A skeletonized organization chart and personnel roster for the Bureau of Land Management and Nevada Department of Highways is attached hereto.

Bureau of Land Management Skeletonized Organization Chart - Attach. 1

Bureau of Land Management Skeletonized Personnel Roster - Attach. 2

Nevada Dept. of Highways Skeletonized Organization Chart - Attach. 3

Nevada Dept. of Highways Skeletonized Personnel Roster - Attach. 4

Bureau of Land Management)
Nevada Dept. of Highways) Administrative areas Attach. 5

IV. RESPONSIBILITIES

A. Bureau of Land Management

Bureau of Land Management is responsible for multiple use management, development and service programs on about 48 million acres of public lands and/or other lands under its jurisdiction. These programs include lands, minerals, range, watershed, recreation, wildlife, timber, protection, cadastral survey, range improvement and roads and trails.

B. The Nevada Department of Highways has the responsibility for planning, designing, constructing, and maintaining those portions of the establishe State highway system under its jurisdiction. This responsibility includes the establishment and maintenance of effective working relationships with all other governmental entities and agencies interested in or affected by the State's highway program.

V. PROCEDURES

Because of the complex nature of many of the Bureau of Land Management and Nevada Department of Highway operations involving interrelated work, this part of the memorandum establishes a framework (1) to hold Bureau of Land Management-Nevada Department of Highways local and State meetings to implement the intent of this agreement; (2) to identify on a continuing basis, functional interrelated work areas, and (3) jointly develop procedures in sufficient detail to guide operations of both Bureau of Land Management and Nevada Department of Highways in such work areas.

A. Coordination Meetings - General Procedures

1. Local Meeting

At least annually a district meeting of the Bureau of Land Management District Manager and Nevada Department of Highways District Engineer and appropriate members of their staffs will be held. This will be done on a Bureau of Land Management - Nevada Department of Highways district basis. The Bureau of Land Management Boise District Manager, when necessary, will attend the Elko meeting; the Bureau of Land Management Susanville District Manager, the Carson City meeting. The meeting will be scheduled by joint action of the Nevada Bureau of Land Management District Manager and Nevada Department of Highways District Engineer. Other groups, agencies and individuals may be invited to attend.

The purpose of the local meetings are:

a. To exchange data, identify additional interrelated work areas, and to keep each agency informed.

b. To review agency responsibilities, programs, priorities, including preliminary plans which may develop into future cooperative efforts. Full recognition will be given to agency annual work plans, short and long range plans, and programming processes to provide adequate time for submission of budget requests. This, in turn, will allow simultaneous scheduling of programs and execution of such interrelated work.

c. To identify unresolved areas that require the attention of the next level of management and/or be included on the agenda for the State meeting.

d. To work out exchanges of manpower, materials, and/or equipment on a temporary and on specific case interrelated work areas where such an arrangement would be to the mutual benefit of both the Bureau of Land Management and Nevada Department of Highways.

2. State Meeting

At least annually and preferably after concluding all the local meetings, a meeting will be scheduled by joint action of the Bureau of Land Management State Director and Nevada Department of Highways Highway Engineer. Agenda items and participants will be discussed as needed before the meeting.

The purposes of the State meeting are:

a. To develop procedures designed to coordinate Bureau of Land Management - Nevada Department of Highways District work on a statewide basis.

b. To assist Bureau of Land Management - Nevada Department of Highway District Offices in their interrelated work goals.

c. To review priorities and designate critical functional and/or geographical areas.

d. To conduct joint evaluations and review of plans and/or completed work.

e. To resolve conflicts.

B. Specific Functional Procedures on Interrelated Work Areas (See Attachment 6).

Bureau of Land Management and Nevada Department of Highways shall collectively develop written procedures on functional interrelated work areas. Such procedures shall by definition become an addendum to this memorandum. Concurrence to add, delete and/or change such procedures will be done through the exchange of correspondence between the Nevada State Director and the Nevada

Department of Highways Highway Engineer.

Attachment 6 is a cataloging of the functional areas where procedures have been developed.

VI. APPROVAL

This joint memorandum replaces and supersedes the Memorandum of Understanding between Nevada Bureau of Land Management State Director and State of Nevada Department of Highways approved June 15, 1971.

Effective this 14th day of August 1972.

STATE OF NEVADA
DEPARTMENT OF HIGHWAYS

BY/S ____________________
GRANT BASTIAN
State Highway Engineer

UNITED STATES DEPARTMENT
OF THE INTERIOR - BUREAU OF
LAND MANAGEMENT

BY/S ____________________
E. I. ROWLAND
State Director, Nevada

CONCUR:

FEDERAL HIGHWAY ADMINISTRATION

BY/S ____________________
CALVIN BERGL
Division Engineer

APPENDIX E

SOIL EROSION AND SEDIMENT CONTROL ACTS

MODEL STATE ACT FOR SOIL EROSION

AND SEDIMENT CONTROL

___________ Bill No. ______

AN ACT to amend the Soil and Water Conservation Districts Law [1] to provide for an acceleration and extension of the program for control of soil erosion and sediment damage resulting from land disturbing activities within the State; to provide for adoption of a comprehensive statewide soil erosion and sediment control program and guidelines and for adoption by soil and water conservation districts [2] of soil erosion and sediment control programs consistent with such statewide program and guidelines; to require the filing and approval of plans for the control of soil erosion and sediment damage in connection with land disturbing activities; to provide for inspections and reports; to declare certain acts to be unlawful; to provide for administration and enforcement; to provide for financial and other assistance to districts and the State Soil and Water Conservation Commission [3] for the purposes of this act, and making an appropriation for those purposes; and for other purposes. [4]

BE IT ENACTED BY The Legislature of the State of __________________ [5] that the Soil and Water Conservation Districts Law [6] shall be amended by adding at the end thereof the following sections:

Section 1. Findings and declaration of policy. The Legislature finds that erosion continues to be a serious problem throughout the State, and that rapid shifts in land use from agricultural and rural to nonagricultural and urbanizing uses, changes in farm and ranch enterprises, operations, and ownership, construction of housing, industrial and commercial developments, streets, highways, recreation areas, schools and universities, public utilities and facilities, and other land disturbing activities have accelerated the process of soil erosion and sediment deposition resulting in pollution of the waters of the State and damage to domestic, agricultural, industrial, recreational, fish and wildlife, and other resource uses. It is, therefore, declared to be the policy of this act to strengthen and extend the present erosion and sediment control activities and programs of this State for both rural and urban lands, and to establish and implement, through the State Soil and Water Conservation Commission,[7] hereinafter referred to as the "Commission," and the soil and water conservation districts,[8] hereinafter referred to as "districts," in cooperation with counties, municipalities and other local governments and subdivisions of this State, and other public and private entities, a statewide comprehensive and coordinated erosion and sediment control program to conserve and protect land, water, air, and other resources of the State.

Section 2. Definitions. (a) "Land disturbing activity" means any land change which may result in soil erosion from water or wind and the movement of sediments into State waters or onto lands in the State, including, but not limited to, tilling, clearing, grading, excavating, transporting and filling of land, other than Federal lands, except that the term shall not include such minor land disturbing activities as home gardens and individual home landscaping, repairs and maintenance work.

(b) "Person" means any individual, partnership, firm, association, joint venture, public or private corporation, trust, estate, commission, board, public or private institution, utility, cooperative, municipality or other political subdivision of this State, any interstate body, or any other legal entity.

(c) "State waters" means any and all waters, public or private, on the surface of the ground, which are contained within, flow through, or border upon the State of ____________________ or any portion thereof.

(d) "Erosion and sediment control plan" or "plan" means a plan for the control of soil erosion and sediment resulting from a land disturbing activity.

(e) "Conservation standards" or "standards" means standards adopted by the Commission or the districts pursuant to sections 3 and 4, respectively, of this act.

Section 3. State erosion and sediment control program.

(a) The commission shall, in cooperation with the State Water Quality Control Agency [9] and other appropriate State and Federal agencies, develop and coordinate a comprehensive state erosion and sediment control program. To assist in the development of such program, the Commission shall name an advisory board of not less than seven nor more than eleven members, representing such interests as housing, financing, industry, agriculture, recreation, and local governments, and their planning, transportation, health, public works, and zoning commissions or agencies.

(b) To implement this program, the Commission shall develop and adopt by __(date)__ guidelines for erosion and sediment control, which guidelines may be revised from time to time as may be necessary. Before adopting or revising guidelines the Commission shall, after giving due notice, [10] conduct public hearings on the proposed guidelines or proposed change in existing guidelines. The guidelines for carrying out the program shall:

(1) be based upon relevant physical and developmental information concerning the watersheds and drainage basins of the State, including, but not limited to, data relating to land use, soils, hydrology, geology, size of land area being disturbed, proximate water bodies and their characteristics, transportation, and public facilities and services;

(2) include such survey of lands and waters as may be deemed appropriate by the Commission or required by any applicable law to identify areas, including multi-jurisdictional and watershed areas, with critical erosion and sediment problems; and

(3) contain conservation standards for various types of soils and land uses, which standards shall include criteria, techniques, and methods for the control of erosion and sediment resulting from land disturbing activities.

(c) The program and guidelines shall be made available for public inspection at the office of the Commission.

Section 4. District erosion and sediment control program.

(a) each district in the State shall, within _______ year(s) after the adoption of the State guidelines, develop and adopt a soil erosion and sediment control program consistent with the State program and guidelines for erosion and sediment control. To assist in developing its program, each district shall name an advisory committee of not less than seven nor more than eleven members representing such interests as housing, financing, industry, agriculture, recreation, and local governments, and their planning, transportation, health, public works, and zoning commissions or agencies. Upon the request of a district the Commission shall assist in the preparation of the district's program. Upon adoption of its program, the district shall submit the program to the Commission for review and approval. If a district fails to submit a program to the Commission within the period specified herein, the Commission shall, after such hearings or consultations as it deems appropriate with the various local interests in the district, develop and adopt an appropriate program to be carried out by the district. In areas where there is no district, the Commission shall designate a local unit of general government such as a county, municipality, town, parish, borough, or township to develop, adopt and carry out the erosion and sediment control program and exercise the responsibilities of a district with respect thereto, as provided in this act.

(b) To carry out its program the district shall, within _________ year(s) after the program has been approved by the Commission, establish, consistent with the State program and guidelines, conservation standards for various types of soils and land uses, which standards shall include criteria, guidelines, techniques, and methods for the control of erosion and sediment resulting from land disturbing activities. Such conservation standards may be revised from time to time as may be necessary. Before adopting or revising conservation standards, the district shall, after giving due notice, conduct a public hearing on the proposed conservation standards or proposed changes in existing standards.

(c) The program and conservation standards shall be made available for public inspection at the principal office of the district.

Section 5. Prohibited land disturbing activities.

(a) Except as provided in subsection (e) of this section, no person may engage in any land disturbing activity until he has submitted to the district a plan for erosion and sediment control for such land disturbing activity and such plan has been reviewed and approved by the district, except that (1) when proposed land disturbing activities are to be performed on State lands or by or on behalf of a State agency, plans for erosion and sediment control shall be submitted to the Commission instead of the district for review and approval, and (2) where land distrubing activities involve lands in more than one district, plans for erosion and sediment control may, as an alternative to submission to each district concerned, be submitted to the Commission for review and approval.

(b) Upon submission of an erosion and sediment control plan to a district or to the Commission:

(1) the district shall review plans submitted to it and shall approve any such plan if it determines that the plan meets the conservation standards of the district, and if the person responsible for carrying out the plan certifies that he will properly perform the erosion and sediment control measures included in the plan and will conform to the provisions of this act;

(2) the Commission shall review plans submitted to it and shall approve any such plan if it determines that the plan is adequate in consideration of the Commission's guidelines and the conservation standards of the district, or districts, involved, and if the person responsible for carrying out the plan certifies that he will properly perform the conservation measures included in the plan and will conform to the provisions of this act.

(c) When a plan submitted for approval under this section is found, upon review by a district or the Commission, to be inadequate, the district or the Commission, as the case may be, may require such modifications, terms, and conditions as will permit approval of the plan.

(d) An approved plan may be changed by the district which has approved the plan or by the Commission when it has approved the plan, where:

(1) inspection has revealed the inadequacy of the plan to accomplish the erosion and sediment control objectives of the plan, and appropriate modifications to correct the deficiencies of the plan are agreed to by the plan approving authority and the person responsible for carrying out the plan; or

(2) the person responsible for carrying out the approved plan finds that because of changed circumstances or for other reasons the approved plan cannot be effectively carried out, and proposed amendments to the plan, consistent with the requirements of this act, are agreed to by the plan approving authority and the person responsible for carrying out the plan.

(e) Any person owning, occupying, or operating private agricultural and forest lands who has a farm or ranch conservation plan approved by the district and is implementing and maintaining such plan with respect to normal agricultural and forestry activities, or any person whose normal agricultural and forestry practices are in conformance with the conservation standards established pursuant to this act, shall not be deemed to be engaged in prohibited land disturbing activity.

If there is not available to any such owner, operator, or occupier at least 50 percent cost-sharing assistance or adequate technical assistance for the installation of erosion and sediment control measures required in an approved farm or ranch plan, or for measures to conform agricultural and forestry practices to conservation standards established pursuant to this act, any such owner, occupier, or operator who shall fail to install erosion and sediment control measures required in an approved farm or ranch conservation plan, or to conform his agricultural and forestry practices to such conservation standards, shall not be deemed to be engaged in prohibited land disturbing activity subject to penalties under the act.

Section 6. Approved plan required for issuance of grading, building, or other permits. No agency authorized under any other law to issue grading, building, or other permits for activities involving land disturbing activities may issue any such permits unless the applicant therefore submits with his application an erosion and sediment control plan approved by the district, or by the Commission where appropriate, and his certification that such plan will be followed. These requirements are in addition to all other provisions of law relating to the issuance of such permits and are not intended to otherwise affect the requirements for such permits.

Section 7. Monitoring, reports, and inspections.

(a) Land disturbing activities where permit is issued. With respect to approved plans for erosion and sediment control in connection with land disturbing activities which involve the issuance of a grading, building, or other permit, the permit issuing authority shall provide for periodic inspections of the land disturbing activity to insure compliance with the approved plan, and to determine whether the measures required in the plan are effective in controlling erosion and sediment resulting from the land disturbing activities.

Notice of such right of inspection shall be included in the permit. If the permit issuing authority determines that the permittee has failed to comply with the plan, the authority shall immediately serve upon the permittee by registered mail to the address specified by the permittee in his permit application a notice to comply. Such notice shall set forth the measures needed to come into compliance with such plan and shall specify the time within which such measures shall be completed. If the permittee fails to comply within the time specified, he shall be deemed to be in violation of this act and upon conviction shall be subject to the penalties provided by the act.

(b) Other land disturbing activities except agricultural and forestry operations. With respect to approved plans for erosion and sediment control in connection with all other land disturbing activities except agricultural and farming operations, the district, or the Commission in connection with plans approved by it, may require of the person responsible for carrying out the plan such monitoring and reports, and may make such on-site inspections after notice to the resident owner, occupier, or operator, as are deemed necessary to determine whether the soil erosion and sediment control measures required by the approved plan are being properly performed, and whether such measures are effective in controlling soil erosion and sediment resulting from the land disturbing activity. Such resident owner, occupier, or operator shall be given an opportunity to accompany the inspectors. If it is determined that there is failure to comply with the approved plan, the district, or the Commission where appropriate, shall serve upon the person who is responsible for carrying out the approved plan a notice to comply, setting forth the measures needed to be taken and specifying the time in which such measures shall be completed. Such notice shall be by registered mail to the person responsible for carrying out the plan at the address specified by him in his certification at the time of obtaining his approved plan. Upon failure of such person to comply within the specified period, he will be deemed to be in violation of the act and subject to the penalties provided by the act.

(c) Agricultural and forestry operations. With respect to agricultural and forestry operations, the district shall have authority to make on-site inspections to determine if the approved farm or ranch conservation plan is being followed, or, where there is no such plan, to determine if the agricultural and forestry practices are being carried out in conformance with conservation standards established pursuant to this act. On-site inspections may be made after notice to the resident owner, operator, or occupier of the land involved, and such person shall be given an opportunity to accompany the inspector. If such inspections reveal that an owner, operator, or occupier of agricultural or forestry lands is not complying with the approved farm or ranch conservation plan or is not carrying out his agricultural and forestry practices in conformance with conservation standards established pursuant to this act, such owner, operator, or occupier shall be notified by registered mail addressed to him at his usual abode or customary place of business of the measures needed for compliance. Such notice shall require that such resident owner, occupier, or operator shall commence such measures within six months from the date of the notice and shall complete the same within twelve months of such date. Upon failure to comply with such notice, the owner, occupier, or operator will be deemed in violation of this act and subject to the penalties provided by the act.

Section 8. Cooperation with Federal agencies. The district and the Commission are authorized to cooperate and enter into agreements with any Federal agency in connection with plans for erosion and sediment control with respect to land disturbing activities on lands which are under the jurisdiction of such Federal agency.

Section 9. Financial and other assistance. The Commission and the districts are authorized to receive from Federal, State, or other public or private sources financial, technical, or other assistance for use in accomplishing the purposes of this act.

Section 10. Appeals. Decisions of the districts, the Commission, and the permit issuing authorities under the provisions of this act shall be subject to review by the ________________ court,[11] provided an appeal is filed within 30 days from the date of any such decision.

Section 11. Penalties, injunctions and other legal actions.

(a) A violation under sections 5 or 7 of this act shall be deemed a misdemeanor and upon conviction shall be subject to a fine not to exceed five hundred dollars or one year's imprisonment for each and every violation. Each day the violation continues shall constitute a separate offense.

(b) The appropriate permit issuing authority, the district, the Commission, or any aggrieved person who suffers damage or is likely to suffer damage because of a violation may apply to the ________________ court[12] for injunctive relief to enjoin a violation or threatened violation under sections 5 or 7 of this act.

(c) The county attorney[13] shall, upon request of a district or the permit issuing authority, take legal action to enforce the provisions of this act. The State attorney general shall, upon request of the Commission, take appropriate legal action on behalf of the Commission to enforce the provisions of this act.

Section 12. Appropriation. (Provision should be made for an appropriation out of funds in the State treasury to finance the activities authorized by this act.)

Section 13. Separability. If any provision of this act is held to be unconstitutional or invalid, such unconstitutionality or invalidity shall not affect the remaining provisions of this act.

Section 14. Effective Date. (Insert effective date of act.)

FOOTNOTES

[1] Substitute such other designation of the State conservation districts law as appropriate.

[2] Substitute such other designation of the districts under the State districts law as appropriate.

[3] Substitute such other name of State agency having jurisdiction over soil and water conservation districts as appropriate

[4] The title should conform to State requirements. This title will be appropriate in most States.

[5] The form of enacting clause should be supplied in conformity with State requirements.

[6] See Note 1 supra.

[7] Substitute such other name of the State agency having jurisdiction over soil and water conservation districts as appropriate.

[8] Substitute such other designation of the districts under the State districts law as appropriate.

[9] Substitute name of State agency having water quality control responsibilities as appropriate.

[10] Districts laws generally contain a definition of "due notice." If the law does not contain such a definition, one should be included in section 2 of this act.

[11] Insert title of the appropriate court.

[12] Insert title of the appropriate court.

[13] Insert appropriate local public legal officer.

EXPLANATORY STATEMENT BY THE CSLC

MODEL STATE LAW FOR SOIL EROSION AND SEDIMENT CONTROL

Soil erosion and sediment controls have long been recognized as a first line of defense against water and air pollution. Preventative in nature, these controls can, when applied effectively in urban, suburban and rural areas, materially reduce the scope of the pollution problem.

For over thirty years, local conservation districts, organized under State law to promote the wise use, care and management of the Nation's land, water and related resources and supervised by a State agency which often has independent responsibilities for the conservation and management of natural resources, have been deeply involved in establishing and maintaining erosion and sediment control measures on agricultural and forest lands. Today, these same districts, which cover over 98 percent of the privately owned lands in the Nation, are directing their attention tothe increase in and acceleration of soil erosion and sediment deposition occasioned by rapid shifts in land uses from agricultural and rural to nonagricultural and urban uses, by changes in farm and ranch enterprises, operations and ownership, by construction of housing, industrial and commercial developments, streets, highways, recreation areas, schools and universities, public utilities and facilities and by other land disturbing activities. Evidence made available by current research suggests, for example, that sediment yields in areas undergoing suburban development can be as much as five to 500 times greater than in rural areas.

The Model Soil Erosion and Sediment Control Law was prepared by a task force acting under a mandate from the Workshop on Soil Erosion which met in conjunction with the Special Committee on District Outlook of the National Association of Conservation Districts on March 15-18, 1972 in Washington, D. C., under the auspices of the National Symposium on State Environmental Legislation. The task force was instructed to submit its completed draft to the Council of State Governments by May 1, 1972.

The Model Law is premised on two basic recommendations agreed to by the Workshop on Soil Erosion. These recommendations are:

1. Responsibility for an erosion and sediment control regulatory program should be placed in the conservation districts which have the responsibility under the laws of all fifty States for the control of erosion and sediment deposition. This responsibility would be in conjunction with, but would not replace, those State and local regulatory programs concerned with the quality of soil and water resources and pollution abatement activities.
2. Suggested State erosion and sediment control legislation should be drafted in the form of an amendment to existing conservation districts' enabling laws.

The general structure and substantative provisions of the Model Law reflect with certain minor revisions, the general principles developed by the Workshop to guide the task force in preparing draft legislation. The report of the Workshop containing these principles is set out in full in the section on Background Material.

The conclusions and recommendations of the Soil Erosion Workshop were based in part on a paper entitled "Approaches to Urban and Rural Erosion and Sediment Control--Administrative and Legislative Actions to Extend State Programs", prepared and presented by Mary M. Garner, Attorney, Office of the General Counsel, U. S. Department of Agriculture. This paper, which is also set out in full in the Background Material section, describes some of the accelerated erosion and sediment control programs inaugurated by conservation districts under their existing legal authorities, identifies various types of legislation adopted by the

States to strengthen State soil erosion and sediment control programs and contains suggestions for accelerating district erosion and sediment control programs. These suggestions include a proposal to amend State soil and water conservation laws similar to the Model Law.

In carrying out its mandate, the task force critically reviewed each provision of the Model Law from the standpoint of practicality and efficacy in achieving the desired objectives of the legislation. The task force is of the opinion that further comments and suggestions regarding these aspects of the legislation would be particularly beneficial. Recognizing that any Model Law must be tailored by each State to comply with its constitutional and statutory requirements, the task force has endeavored to set down in as clear and straightforward a manner as possible the essential requirements of an effective soil erosion and sediment control law.

Principal authorities and requirements of the Model Law include:

1. Establishment of a comprehensive State soil erosion and sediment control program applicable to different types of land use and soil conditions, with identification of areas having critical soil erosion and sediment problems; adoption of statewide guidelines including conservation standards for the control of erosion and sediment resulting from land disturbing activities.

2. Establishment of district soil erosion and sediment control programs and conservation standards consistent with the State program and guidelines.

3. Prohibition of certain land disturbing activities unless conducted in accordance with approved soil erosion and sediment control plans, with special requirements applicable to land disturbing activities resulting from normal agricultural and forestry activities.

4. Use of existing regulatory mechanisms, such as building, grading and other permits applicable to land disturbing activities, to implement erosion and sediment control plan requirements.

5. Inspection, monitoring and reporting requirements. Provision for modification of approved plans by mutual agreement.

6. Penalties, injunctions and other enforcement provisions.

7. Appropriations to carry out the act.

BACKGROUND MATERIAL - MODEL STATE ACT

1. Workshop Report on Soil Erosion, National Symposium on State Environmental Legislation, March 15-18, 1972, Washington, D. C.
2. "Approaches to Urban and Rural Erosion and Sediment Control, Administrative and Legislative Actions to Extend State Programs", by Mary M. Garner, Attorney, Office of the General Counsel, U. S. Department of Agriculture.
3. "Community Action Guidebook for Soil Erosion and Sediment Control" by Mel D. Powell, William C. Winter, William P. Bodwitch, National Association of Counties Research Foundation, March 1970.
4. "Controlling Erosion on Construction Sites", U. S. Department of Agriculture Information Bulletin 347, December 1970.

THE CLEAN STREAMS LAW OF PENNSYLVANIA

INCLUDING
ALL AMENDMENTS
TO THE END OF THE
LEGISLATIVE SESSION
OF 1970

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES

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FOREWORD

This publication contains "The Clean Streams Law" as amended through 1970. An explanation of the administration of the law is necessary by reason of Act 275, approved December 3, 1970 (House Bill 2213, Pr. No. 3631) which established the Department of Environmental Resources effective January 19, 1971.

Act 275 abolished the Sanitary Water Board and the Department of Mines and Mineral Industries and transferred their duties and functions under "The Clean Streams Law" to the new department. In addition to other extensive changes in state government, the Act also transferred to the new department all of the environmental protection functions of the Department of Health.

Act 275 also created two departmental boards known as the Environmental Quality Board, responsible for developing the Commonwealth's environmental plan and for promulgating rules and regulations for the new department, and the Environmental Hearing Board, responsible for holding hearings and issuing adjudications in accordance with rules of procedure adopted by the Environmental Quality Board. Existing rules and regulations of the Sanitary Water Board remain in effect until changed or repealed by the Environmental Quality Board.

An advisory board, known as the Citizens Advisory Council, was also established in the department and is responsible for rendering advice to the department and for reviewing and recommending changes in "The Clean Streams Law" and other environmental laws of the Commonwealth.

As a result of the foregoing, references in "The Clean Streams Law" must be interpreted to conform with these changes in governmental structure. Accordingly, references in the law to the Department of Health and the Department of Mines and Mineral Industries should be interpreted as referring to the Department of Environmental Resources; references to the Sanitary Water Board in its policy or rule making capacity should be interpreted as referring to the Environmental Quality Board; references to the Sanitary Water Board in its appellate or adjudicatory capacity should be interpreted as referring to the Environmental Hearing Board; and other references to the Sanitary Water Board should be interpreted as referring to the Department of Environmental Resources.

TABLE OF CONTENTS

ARTICLE I - GENERAL PROVISIONS AND PUBLIC POLICY

Section Number	Title of Section	Page Number
1.	Definitions	1
2.	Interpretation of Act	2
3.	Discharge of Sewage and Industrial Wastes Not a Natural Use	2
4.	Declaration of Policy	3
5.	Powers and Duties	3
6.	Application and Permit Fees	4
7.	Administrative Procedure and Judicial Review	4
8.	Clean Water Fund	4

ARTICLE II - SEWAGE POLLUTION

Section Number	Title of Section	Page Number
201.	Prohibition Against Discharge of Sewage	5
202.	Sewage Discharges	5
203.	Municipal Sewage	6
207.	Approval of Plans, Designs, and Relevant Data by the Sanitary Water Board	7
209.	Prohibition Against Discharge of Sewage, et cetera, After Revocation of Permit	7
210.	Duties of Municipalities	7
211.	Revenue Bonds	7
212.	Issuance and Sale of Revenue Bonds; Maturity; Interest	8
213.	Other Methods of Financing Preserved	8

ARTICLE III - INDUSTRIAL WASTES

Section Number	Title of Section	Page Number
301.	Prohibition Against Discharge of Industrial Wastes	8
303.	Information as to Kind and Character of Discharge	9
304.	Water Surveys	9
305.	Investigations and Research	9
307.	Industrial Waste Discharges	9
308.	Approval of Plans, Designs, and Relevant Data by the Department	10
314.	Authorizing Certain Corporations to Acquire Interests in Land by Eminent Domain	10
315.	Operation of Mines	11
316.	Responsibilities of Landowners and Land Occupiers	12

ARTICLE IV - OTHER POLLUTIONS AND POTENTIAL POLLUTION

Section Number	Title of Section	Page Number
401.	Prohibition Against Other Pollutions	12
402.	Potential Pollution	13

THE CLEAN STREAMS LAW

Approved

June 22, 1937, Act 394, P.L. 1987

Amended

May 8, 1945, Act 177, P.L. 435
April 20, 1956, Act 489, P.L. 1479
August 23, 1965, Act 194, P.L. 372
July 31, 1970, Act 222

Entitled

AN ACT

To preserve and improve the purity of the waters of the Commonwealth for the protection of public health, animal and aquatic life, and for industrial consumption, and recreation; empowering and directing the creation of indebtedness or the issuing of non-debt revenue bonds by political subdivisions to provide works to abate pollution; providing protection of water supply; providing for the jurisdiction of courts in the enforcement thereof; providing additional remedies for abating pollution of waters; imposing certain penalties; repealing certain acts; regulating discharges of sewage and industrial wastes; regulating the operation of mines; and placing responsibilities upon landowners and land occupiers.

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THE CLEAN STREAMS LAW

ARTICLE I

GENERAL PROVISIONS AND PUBLIC POLICY

SECTION 1. DEFINITIONS

Be it enacted, &c., That the following words or phrases, unless the context clearly indicates otherwise, shall have the meanings ascribed to them in this section.

"Board" shall be construed to mean the Sanitary Water Board in the Department of Health, or its duly constituted successor, except for the purposes of this act, the board shall, in addition to those persons designated as members by section 439 of the act of April 9, 1929 (P.L. 177), known as "The Administrative Code of 1929," include as a member a person designated by the Chairman of the State Soil and Water Conservation Commission, which person shall have all the rights, privileges and duties, and shall receive the allowances and reimbursements established by law for members of the Sanitary Water Board.

"Department" means the Department of Health of the Commonwealth of Pennsylvania, except that in connection with a matter involving a bituminous strip mine or a matter involving a coal mine refuse disposal area, "department" shall mean the Department of Mines and Mineral Industries of the Commonwealth of Pennsylvania.

"Establishment" shall be construed to include any industrial establishment, mill, factory, tannery, paper or pulp mill, garage, oil refinery, oil well, boat, vessel, mine, coal colliery, breaker, coal processing operation, dredging operations, except where the dredger holds an unexpired and valid permit issued by the Pennsylvania Water and Power Resources Board prior to the effective date of this act, quarry, and each and every other industry or plant or works.

"Industrial waste" shall be construed to mean any liquid, gaseous, radioactive, solid or other substance, not sewage, resulting from any manufacturing or industry, or from any establishment, as herein defined, and mine drainage, silt, coal mine solids, rock, debris, dirt and clay from coal mines, coal collieries, breakers or other coal processing operations. "Industrial waste" shall include all such substances whether or not generally characterized as waste.

"Institution" shall include healing, preventive, mental, health, educational, correctional and penal institutions, almshouses, and county and city homes operated by the State, or any political subdivison thereof, and whose sewage is not admitted to a public sewer system.

"Mine" shall be construed to mean any coal mine, clay mine or other facility from which minerals are extracted from the earth.

"Municipality" shall be construed to include any county, city, borough, town, township, school district, institution, or any authority created by any one or more of the foregoing.

"Person" shall be construed to include any natural person, partnership, association or corporation. Whenever used in any clause prescribing and imposing a penalty, or imposing a fine or imprisonment, or both, the term "person" shall include the members of an association and the officers of a corporation.

"Pollution" shall be construed to mean contamination of any waters of the Commonwealth such as will create or is likely to create a nuisance or to render such waters harmful, detrimental or injurious to public health, safety or welfare, or to domestic, municipal, commercial, industrial, agricultural, recreational, or other legitimate beneficial uses, or to livestock, wild animals, birds, fish or other aquatic life, including but not limited to such contamination by alteration of the physical, chemical or biological properties of such waters, or change in temperature, taste, color or odor thereof, or the discharge of any liquid, gaseous, radioactive, solid or other substances into such waters. The board shall determine when a discharge constitutes pollution, as herein defined, and shall establish standards whereby and wherefrom it can be ascertained and determined whether any such discharge does or does not constitute pollution as herein defined.

"Sewage" shall be construed to include any substance that contains any of the waste products or excrementitious or other discharge from the bodies of human beings or animals.

"Waters of the Commonwealth" shall be construed to include any and all rivers, streams, creeks, rivulets, impoundments, ditches, water courses, storm sewers, lakes, dammed water, ponds, springs and all other bodies or channels of conveyance of surface and underground water, or parts thereof, whether natural or artificial, within or on the boundaries of this Commonwealth.

SECTION 2. INTERPRETATION OF ACT

A. The provisions of this Act are severable, and if any of its provisions shall be held unconstitutional, the decision of the court shall not affect or impair any of the remaining provisions of this act. It is hereby declared to be the legislative intent that this act would have been adopted had such unconstitutional provisions not been included herein.

B. Section headings shall not be taken to govern or limit the scope of the sections of this act. The singular shall include the plural, and the masculine shall include the feminine and neuter.

SECTION 3. DISCHARGE OF SEWAGE AND INDUSTRIAL WASTES NOT A NATURAL USE

The discharge of sewage or industrial waste or any substance into the waters of this Commonwealth, which causes or contributes to pollution as herein defined or creates a danger of such pollution is hereby declared not to be a reasonable or natural use of such waters, to be against public policy and to be a public nuisance.

SECTION 4. DECLARATION OF POLICY

(1) Clean, unpolluted streams are absolutely essential if Pennsylvania is to attract new manufacturing industries and to develop Pennsylvania's full share of the tourist industry.

(2) Clean, unpolluted water is absolutely essential if Pennsylvanians are to have adequate out of door recreational facilities in the decades ahead;

(3) It is the objective of the Clean Streams Law not only to prevent further pollution of the waters of the Commonwealth, but also to reclaim and restore to a clean, unpolluted condition every stream in Pennsylvania that is presently polluted;

(4) The prevention and elimination of water pollution is recognized as being directly related to the economic future of the Commonwealth; and

(5) The achievement of the objective herein set forth requires a comprehensive program of watershed management and control.

SECTION 5. POWERS AND DUTIES

(a) The board and the department, in adopting rules and regulations, in establishing policy and priorities, in issuing orders or permits, and in taking any other action pursuant to this act, shall, in the exercise of sound judgment and discretion, and for the purpose of implementing the declaration of policy set forth in section 4 of this act, consider, where applicable, the following:

(1) Water quality management and pollution control in the watershed as a whole;

(2) The present and possible future uses of particular waters;

(3) The feasibility of combined or joint treatment facilities;

(4) The state of scientific and technological knowledge;

(5) The immediate and long-range economic impact upon the Commonwealth and its citizens.

(b) The board shall have the power and its duty shall be to:

(1) Formulate, adopt, promulgate and repeal such rules and regulations and issue such orders as are necessary to implement the provisions of this act.

(2) Establish policies for effective water quality control and water quality management in the Commonwealth of Pennsylvania and coordinate and be responsible for the development and implementation of comprehensive public water supply, waste management and other water quality plans.

(3) Review all Commonwealth research programs pertaining to public water supply, water quality control and water quality management: Provided, however, That this section shall not be construed to limit the authority of each department to conduct research programs and operations as authorized by law.

(4) Report from time to time to the Legislature and to the Governor on the Commonwealth's public water supply and water quality control program.

(c) The Department of Health shall have the power and its duty shall be to direct the Commonwealth's water quality control program pursuant to the provisions of this act and to the rules, regulations and policies established by the board and it shall provide such administrative services for the board as the board may require.

(d) The department shall have the power and its duty shall be to:

(1) Review and take appropriate action on all permit applications submitted pursuant to the provisions of this act and to issue, modify, suspend or revoke permits pursuant to this act and to the rules and regulations of the board. Notwithstanding any provision of this act providing for the board to issue, modify, suspend or revoke permits, the department may take such action if authorized to do so by the rules and regulations of the board.

(2) Receive and act upon complaints.

(3) Issue such orders as may be necessary to implement the provisions of this act or the rules and regulations of the board.

(4) Make such inspections of public or private property as are necessary to determine compliance with the provisions of this act, and the rules, regulations, orders or permits issued hereunder.

(5) Report to, and at the direction of, the board.

(6) Perform such other duties as the board may direct.

SECTION 6 APPLICATION AND PERMIT FEES

The department is hereby authorized to charge and collect from persons and municipalities in accordance with the rules and regulations of the board reasonable filing fees for applications filed and for permits issued.

SECTION 7. ADMINISTRATIVE PROCEDURE AND JUDICIAL REVIEW

(a) Any person or municipality who shall be aggrieved by any action of the department under this act shall have the right to appeal such action to the board.

(b) The board may adopt rules and regulations establishing the procedure for, and limiting the time of, the taking of such appeals. Hearings may be held before one or more members of the board or before a hearing examiner appointed by the board. When a board member serves as a hearing officer, he shall be entitled to receive an additional fifty dollars ($50.00) per diem.

(c) The board shall be subject to the provisions of the Administrative Agency Law, approved June 4, 1945 (P.L. 1388), and its amendments.

SECTION 8. CLEAN WATER FUND

(a) All fines collected under the penal provisions of this act and all civil penalties collected under section 605 of this act shall be paid into the Treasury of the Commonwealth in a special fund known as "The Clean Water Fund," which shall be administered by the Sanitary Water Board for use in the elimination of pollution.

(b) The department may, pursuant to the rules and regulations adopted by the board, in the case of a discharge which is authorized only if pursuant to a permit issued by the department, accept payments which would be paid into The Clean Water Fund in lieu of requiring the permittee to construct or operate a treatment facility. Such rules and regulations allowing such payments shall include the following:

(1) That the department finds that the use of the funds so received would provide greater benefit to citizens of the Commonwealth and

would more appropriately conform to the declarations of policy of this act than would the construction and operation of a treatment facility.

(2) That in determining the amounts of such payments, the department shall consider the cost of construction and operation of a treatment facility, the quantity and quality of the discharge, the effect of the discharge on waters of the Commonwealth, the period of time for which the discharge will continue and other relevant factors.

(3) That the permit authorizing the discharge be subject to such conditions as the department might impose, including conditions relating to procedures for the effective cessation of any pollutional discharge upon closing of the operation.

(4) That allowing the discharge will not adversely affect any treatment program which is being conducted or is contemplated in the watershed in which the discharge is located.

(5) That any such payments accepted in lieu of requiring the permittee to construct or operate a treatment facility shall be used for abatement programs or the construction of consolidated treatment facilities which would be more effective than a larger number of smaller programs or facilities, and further, that such funds shall be used only for such projects, including gathering and collection systems, on the watershed or on the body of water into which such permittee is discharging.

ARTICLE II

SEWAGE POLLUTION

SECTION 201. PROHIBITION AGAINST DISCHARGE OF SEWAGE

No person or municipality shall place or permit to be placed, or discharge or permit to flow, or continue to discharge or permit to flow, into any of the waters of the Commonwealth, any sewage, except as hereinafter provided in this act.

SECTION 202. SEWAGE DISCHARGES

No municipality or person shall discharge or permit the discharge of sewage in any manner, directly or indirectly, into the waters of this Commonwealth unless such discharge is authorized by the rules and regulations of the board or such person or municipality has first obtained a permit from the department. Such permit before being operative shall be recorded in the office of the recorder of deeds for the county wherein the outlet of said sewer system is located and in case the municipality or person fails or neglects to record such permit, the department shall cause a copy thereof to be so recorded, and shall collect the cost of recording from the municipality or person. No such permit shall be construed to permit any act otherwise forbidden by any decree, order, sentence or judgement of any court, or by the ordinances of any municipality, or by the rules and regulations of any water company supplying water to the public, or by laws relative to navigation. For the purposes of this section, a discharge of sewage into the waters of the Commonwealth shall include a discharge of sewage by a person or municipality into a sewer system or other facility owned, operated or maintained by another person or municipality and which then flows into the waters of the Commonwealth. A discharge of sewage without a permit or contrary to the terms and conditions of a permit or contrary to the rules and regulations of the board is hereby declared to be a nuisance.

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SECTION 203. MUNICIPAL SEWAGE

(a) Whether or not a municipality is required by other provisions of this act to have a permit for the discharge of sewage, if the department finds that the acquisition, construction, repair, alteration, completion, extension or operation of a sewer system or treatment facility is necessary to properly provide for the prevention of pollution or prevention of a public health nuisance, the department may order such municipality to acquire, construct, repair, alter, complete, extend, or operate a sewer system and/or treatment facility. Such order shall specify the length of time, after receipt of the order, within which such action shall be taken.

(b) The department may from time to time order a municipality to file a report with the department pertaining to sewer systems or treatment facilities owned, operated, or maintained by such municipality or pertaining to the effect upon the waters of the Commonwealth of any sewage discharges originating from sources within the municipality. The report shall contain such plans, facts, and information which the department may require to enable it to determine whether existing sewer systems and treatment facilities are adequate to meet the present and future needs or whether the acquisition, construction, repair, alteration, completion, extension, or operation of a sewer system or treatment facility should be required to meet the objectives of this act. Whether or not such reports are required or received by the department, the department may issue appropriate orders to municipalities where such orders are found to be necessary to assure that there will be adequate sewer systems and treatment facilities to meet present and future needs or otherwise to meet the objectives of this act. Such orders may include, but shall not be limited to, orders requiring municipalities to undertake studies, to prepare and submit plans, to acquire, construct, repair, alter, complete, extend, or operate a sewer system or treatment facility, or to negotiate with other municipalities for combined or joint sewer systems or treatment facilities. Such orders may prohibit sewer system extensions, additional connections, or any other action that would result in an increase in the sewage that would be discharged into an existing sewer system or treatment facility.

SECTION 204. (Repealed)

SECTION 205. (Repealed)

SECTION 206. (Repealed)

SECTION 207. APPROVAL OF PLANS, DESIGNS, AND RELEVANT DATA BY THE SANITARY WATER BOARD

All plans, designs, and relevant data for the construction of any new sewer system, or for the extension of any existing sewer system, by a municipality, or for the erection, construction, and location of any treatment works or intercepting sewers by a person or municipality, shall be submitted to the board for its approval before the same are constructed or erected or acquired. Any such construction or erection which has not been approved by the board by written permit, or any treatment works not operated or maintained in accordance with the rules and regulations of the board, is hereby also declared to be a nuisance and abatable as herein provided.

SECTION 208. (REPEALED)

SECTION 209. PROHIBITION AGAINST DISCHARGE OF SEWAGE, ET CETERA, AFTER REVOCATION OF PERMIT

On the expiration of the period of time prescribed, after the service of a notice of revocation, modification or change of any such permit from the board, the discharge of sewage into any waters of the Commonwealth or treated sewage from treatment works shall cease and terminate, and the prohibition of this act against such discharge or treatment shall be in full force as though no permit has been granted, but a new permit may thereafter again be granted, as hereinbefore provided. A continuation of the discharge of sewage or the treatment of sewage after revocation, or in violation of any modification and change of any such permit, is hereby also declared to be a nuisance, and shall be punishable and abatable, as herein provided.

SECTION 210. DUTIES OF MUNICIPALITIES

It shall be the duty of the corporate authorities of a municipality upon whom an order is issued pursuant to section 203 of this act to proceed diliquently in compliance with such order. If the corporate authorities fail to proceed diligently, or if the municipality fails to comply with the order within the specified time, the corporate authorities shall be guilty of comtempt and shall be punished by the court in an appropriate manner and, for this purpose, application may be made by the Attorney General to the Court of Common Pleas of Dauphin County, until such time as the Commonwealth Court comes into existence and thereafter the Commonwealth Court instead of said Court of Common Pleas of Dauphin County, or to the court of common pleas of the county wherein the municipality is situated, which courts are hereby given jurisdiction.

SECTION 211. REVENUE BONDS

For the purpose of financing the cost and expense, or its share of the cost and expense, of constructing or acquiring or extending any sewer, sewer system or sewage treatment works, either singly or jointly with other municipalities, a municipality may issue non-debt revenue bonds secured solely by a pledge, in whole or in part, of the annual rentals or charges imposed for the use of such sewer, sewer system or sewage treatment works. Said bonds shall not pledge the credit, nor create any debt, nor be a charge against the general revenues, nor be a lien against any property of the municipality, but shall be a lien upon and payable solely from the annual rentals or charges for the use of the sewer, sewer system or sewage treatment works.

SECTION 212. ISSUANCE AND SALE OF REVENUE BONDS; MATURITY; INTEREST

When a municipality shall issue any non-debt revenue bonds, the corporate authorities thereof shall sell the same to the highest bidder after public notice by advertisement once a week for three weeks, in at least one newspaper of general circulation, published in the municipality or the county in which the municipality is situate. Where bonds shall be advertised for sale as herein provided, and no bids shall have been received, then it shall be lawful for such municipality to sell the same at private sale for not less than par and accrued interest.

All such bonds shall be payable in not more than thirty years from the date of their issue, shall be issued in series payable in equal annual installments, and shall bear interest at a rate not exceeding six per centum per annum.

SECTION 213. OTHER METHODS OF FINANCING PRESERVED

Anything in this act to the contrary notwithstanding, any municipality shall have power to issue bonds, revenue certificates or other obligations to finance, in whole or in part, the carrying out of any order or direction of the board without regard to the restrictions, limitations or provisions of this act relating to the issuance of bonds, revenue certificates or other obligations: Provided, That such bonds, revenue certificates or other obligations are issued by the municipality in accordance with the provisions of any other law. This act shall be construed to provide an alternative method for the issuance of bonds, revenue certificates or other obligations by a municipality, and not an exclusive method therefor.

ARTICLE III

INDUSTRIAL WASTES

SECTION 301. PROHIBITION AGAINST DISCHARGE OF INDUSTRIAL WASTES

No person or municipality shall place or permit to be placed, or discharged or permit to flow, or continue to discharge or permit to flow, into any of the waters of the Commonwealth any industrial wastes, except as hereinafter provided in this act.

SECTION 302. (Repealed)

SECTION 303. INFORMATION AS TO KIND AND CHARACTER OF DISCHARGE

Every person who, on the effective date of this act, shall be discharging or permitting to be discharged or has an establishment temporarily closed which, in the future, may discharge or permit to be discharged, any industrial waste into the waters of the Commonwealth, shall file with the board within ninety days after the effective date of this act, on forms prepared and supplied by the board, such information, under oath, as the board may require with regard to such industrial waste, including the kind, characteristics, and rate of flow thereof, and concerning the treatment works, if any, either in operation or in contemplation. It shall be the duty of such persons to apply to the board for the forms necessary to comply with this provision. The falsity of any of the information thus supplied is hereby declared to be perjury and punishable as such.

SECTION 304. WATER SURVEYS

The board shall have power to make a complete survey of the waters of the Commonwealth in order to ascertain the extent of pollution in each of said waters, and the remedies to be employed to purify said waters. It shall have power to adopt, prescribe, and enforce such rules and regulations, not inconsistent with this act, as may be deemed necessary for the protection of the purity of the waters of the Commonwealth, or parts thereof, and to purify those now polluted, and to assure the proper and practical operation and maintenance of treatment works approved by it. A violation of which rules and regulations, after notice, shall also constitute a nuisance under this act.

SECTION 305. INVESTIGATIONS AND RESEARCH

In addition to any powers now possessed, the board shall investigate and ascertain, as far as practicable, all facts in relation to the pollution of the waters of the Commonwealth by industrial waste. Its agents may enter upon lands, buildings, and premises as may be necessary for its investigations. It shall conduct scientific experiments and researches under its personal supervision or in colleges and universities for the purpose of ascertaining reasonable and practical means for the treatment of industrial waste, so that when the same has been treated the effluent thereof, when discharged into the waters of the Commonwealth, shall not be injurious to the public health or to animal or aquatic life, or prevent the use of the water for domestic, industrial or recreational purposes.

SECTION 306. (REPEALED)

SECTION 307. INDUSTRIAL WASTE DISCHARGES

No person or municipality shall discharge or permit the discharge of industrial wastes in any manner, directly or indirectly, into any of the waters of the Commonwealth unless such discharge is authorized by the rules and regulations of the board or such person or municipality has first obtained a permit from the Department. For the purposes of this section, a discharge of industrial wastes into the waters of the Commonwealth shall include a discharge of industrial wastes by a person or municipality into a sewer system or other facility owned, operated or maintained by another person or municipality and which then flows into the waters of the Commonwealth. Public notice of every application for a permit under this section shall be given by notice published in a newspaper of general circulation, published in the county where the permit is applied for, once a week for four weeks. A discharge of industrial wastes without a permit or contrary to the terms and conditions of a permit or contrary to the rules and regulations of the board is hereby declared to be a nuisance.

SECTION 308. APPROVAL OF PLANS, DESIGNS, AND RELEVANT DATA BY THE DEPARTMENT

All plans, designs, and relevant data for the erection and construction of treatment works by any person or municipality for the treatment of industrial wastes shall be submitted to the department for its approval before the works are constructed or erected. Any such construction or erection which has not been approved by the department by written permit, or any treatment works not maintained or operated in accordance with the rules and regulations of the board, is hereby declared to be a nuisance.

SECTION 309. (REPEALED)

SECTION 310. (REPEALED)

SECTION 311. (REPEALED)

SECTION 312. (REPEALED)

SECTION 313. (REPEALED)

SECTION 314. AUTHORIZING CERTAIN CORPORATIONS TO ACQUIRE INTERESTS IN LAND BY EMINENT DOMAIN

Whenever the Sanitary Water Board shall direct any corporation to cease discharging industrial waste into any waters of the Commonwealth, pursuant to the public policy set forth in this act, and such directive would materially affect the operations of that corporation's business, then such corporation if not otherwise vested with the right of eminent domain may make application to the board for an order, finding that the use by the applicant of a specified interest in a specifically described piece of land is necessary in connection with the elimination, reduction or control of the pollution of any of the waters of this Commonwealth.

For the purposes of this act, such corporations are vested with the right of eminent domain which shall be exercised only upon authorization of the board, in which event they shall proceed in the manner and form set forth in the "Eminent Domain Code," act of June 22, 1964 (P.L. 84), as amended: Provided, That no property devoted to a public use or owned by a public utility or used as a place of public worship or used for burial purposes shall be taken under the right of eminent domain: And provided further, That where any existing public street or road is vacated by any municipality in order to facilitate any undertaking in connection with land acquired under the right of eminent domain as provided for above, the corporation acquiring such land shall reimburse all public utilities, municipalities and municipality authorities for the cost of relocating and reconstructing their facilities necessitated by the closing of any such street or road.

In the event the application by the corporation to the board is denied, then the corporation so applying may appeal to the court of common pleas in the county where the specified land in which the specified interest is sought to be obtained by eminent domain is situated, and the court shall be empowered to review all questions of fact as well as of law.

SECTION 315. OPERATION OF MINES

(a) No person or municipality shall operate a mine or allow a discharge from a mine into the waters of the Commonwealth unless such operation or dishcarge is authorized by the rules and regulations of the board or such person or municipality has first obtained a permit from the department. Operation of the mine shall include preparatory work in connection with the opening or reopening of a mine, backfilling, sealing, and other closing procedures, and any other work done on land or water in connection with the mine. A discharge from a mine shall include a discharge which occurs after mining operations have ceased, provided that the mining operations were conducted subsequent to January 1, 1966, under circumstances requiring a permit from the Sanitary Water Board under the provisions of section 315 (b) of this act as it existed under the amendatory act of August 23, 1965 (P.L. 372). The operation of any mine or the allowing of any discharge without a permit or contrary to the terms or conditions of a permit or contrary to the rules and regulations of the board, is hereby declared to be a nuisance. Whenever a permit is requested to be issued pursuant to this subsection, and such permit is requested for permission to operate any mining operations, the city, borough, incorporated town or township in which the operation is to be conducted shall be notified by registered mail of the request, at least ten days before the issuance of the permit or before a hearing on the issuance, whichever is first.

(b) The department may require an applicant for a permit to operate a mine, or a permittee holding a permit to operate a mine under the provisions of this section, to post a bond or bonds in favor of the Commonwealth of Pennsylvania and with good and sufficient sureties acceptable to the department to insure that there will be compliance with the law, the rules and regulations of the board, and the provisions and conditions of such permit including conditions pertaining to restoration measures or other provisions insuring that there will be no polluting discharge after mining operations have ceased. The department shall establish the amount of the bond required for each operation and may, from time to time, increase or decrease such amount. Liability under each bond shall continue until such time as the department determines that there is no further significant risk of a pollutional discharge. The failure to post a bond required by the department shall be sufficient cause for withholding the issuance of a permit or for the revocation of an existing permit.

SECTION 316. RESPONSIBILITIES OF LANDOWNERS AND LAND OCCUPIERS

Whenever the Sanitary Water Board finds that pollution or a danger of pollution is resulting from a condition which exists on land in the Commonwealth the board may order the landowner or occupier to correct the condition in a manner satisfactory to the board or it may order such owner or occupier to allow a mine operator or other person or agency of the Commonwealth access to the land to take such action. For the purpose of this section, "landowner" includes any person holding title to or having a proprietary interest in either surface or subsurface rights.

For the purpose of collecting or recovering the expense involved in correcting the condition, the board may assess the amount due in the same manner as civil penalties are assessed under the provisions of section 605 of this act: Provided, however, That if the board finds that the condition causing pollution or a danger of pollution resulted from mining operations conducted prior to January 1, 1966, or, if subsequent to January 1, 1966, under circumstances which did not require a permit from the Sanitary Water Board under the provisions of section 315 (b) of this act as it existed under the amendatory act of August 23, 1965 (P.L. 372), then the amount assessed shall be limited to the increase in the value of the property as a result of the correction of the condition.

If the board finds that the pollution or danger of pollution results from an act of God in the form of sediment from land for which a complete conservation plan has been developed by the local soil and water conservation district and the Soil Conservation Service, U.S.D.A. and the plan has been fully implemented and maintained, the landowner shall be excluded from the penalties of this act.

SECTION 317. (REPEALED)

ARTICLE IV

OTHER POLLUTIONS AND POTENTIAL POLLUTION

SECTION 401. PROHIBITION AGAINST OTHER POLLUTIONS

It shall be unlawful for any person or municipality to put or place into any of the waters of the Commonwealth, or allow or permit to be discharged from property owned or occupied by such person or municipality into any of the waters of the Commonwealth, any substance of any kind or character resulting in pollution as herein defined. Any such discharge is hereby declared to be a nuisance.

SECTION 402. POTENTIAL POLLUTION

(a) Whenever the board finds that any activity, not otherwise requiring a permit under this act, inlcuding but not limited to the impounding, handling, storage, transportation, processing or disposing of materials or substances, creates a danger of pollution of the waters of the Commonwealth or that regulation of the activity is necessary to avoid such pollution, the board may, by rule or regulation, require that such activity be conducted only pursuant to a permit issued by the department or may otherwise establish the conditions under which such activity shall be conducted, or the board may issue an order to a person or municipality regulating a particular activity. Rules and regulations adopted by the board pursuant to this section shall give the persons or municipalities affected a reasonable period of time to apply for and obtain any permits required by such rules and regulations.

(b) Whenever a permit is required by rules and regulations issued pursuant to this section, it shall be unlawful for a person or municipality to conduct the activity regulated except pursuant to a permit issued by the department. Conducting such activity without a permit, or contrary to the terms or conditions of a permit or conducting an activity contrary to the rules and regulations of the board or conducting an activity contrary to an order issued by the department, is hereby declared to be a nuisance.

SECTION 403. (REPEALED)

ARTICLE V

DOMESTIC WATER SUPPLIES

SECTION 501. PROTECTION OF DOMESTIC WATER SUPPLIES

In addition to the powers and authority hereinbefore granted, power and authority is hereby conferred upon the board, after due notice and public hearing, to make, adopt, promulgate, and enforce reasonable orders and regulations for the protection of any source of water, approved by the Commissioner of Health or the Department of Health, for present or future supply to the public, and prohibiting the pollution of any such source of water, so approved, rendering the same inimical or injurious to the public health or objectionable for public water supply purposes.

SECTION 502. PENALTY

Any person violating any of said orders and regulations of the board, or refusing or omitting to comply with any direction or stipulation of the Secretary of Health made in accordance with said orders and regulations after thrity days' notice therof, shall, upon conviction in a summary proceeding, be sentenced to pay a fine of not less than one hundred dollars nor more than five hundred dollars, and, in default of the payment of such fine and costs of prosecution, the person, or if such person be an association or copartnership, then the members thereof, or if such person be a corporation, then the officers thereof, shall be imprisoned in the county jail for a period of sixty days.

Any person who shall continue to violate the orders and regulations of the board, or refuse or omit to comply with any direction or stipulation of the Secretary of Health, after conviction in a summary proceeding, as above provided, shall be guilty of a misdemeanor, and, upon conviction thereof in the court of quarter sessions, shall be sentenced to pay a fine of not less than five hundred dollars nor more than one thousand dollars, and the person, or if such person be an association or copartnership, then the members thereof, or if such person be a corporation, then the officers thereof, shall be imprisoned in the county jail for a period of not less than three months nor more than one year.

SECTION 503. PUBLIC NUISANCES

A violation of the orders and regulations adopted by the board, pursuant to section five hundred and one of this act, shall constitute a nuisance, and whenever such a pollution shall be maintained or continued contrary to such orders and regulations, the same may be abatable in the manner provided by this Act.

ARTICLE VI

PROCEDURE AND ENFORCEMENT

SECTION 601. ABATEMENT OF NUISANCES; RESTRAINING VIOLATIONS

(a) Any activity or condition declared by this act to be a nuisance, shall be abatable in the manner provided by law or equity for the abatement of public nuisances. In addition, suits to abate such nuisances or suits to restrain or prevent any violation of this act may be instituted in equity or at law in the name of the Commonwealth upon relation of the Attorney General, or upon relation of any district attorney of any county, or upon relation of the solicitor of any municipality affected, after notice has first been served upon the Attorney General of the intention of the district attorney or solicitor to so proceed. Such proceedings may be prosecuted in the Commonwealth Court, or in the court of common pleas of the county where the activity has taken place, the condition exists, or the public affected, and to that end jurisdiction is hereby conferred in law and equity upon such courts: Provided, however, That no action shall be brought by such district attorney or solicitor against any municipality discharging sewage under a permit of the board heretofore issued or hereafter issued under this act: And provided further, That, except in cases of emergency where, in the opinion of the court, the exigencies of the cases require immediate abatement of said nuisances, the court may, in its decree, fix a reasonable time during which the person or municipality responsible for the nuisances may make provision for the abatement of the same.

(b) In cases where the circumstances require it or the public health is endangered, a mandatory preliminary injunction or special injunction may be issued upon the terms prescribed by the court, notice of the application therefor having been given to the defendant in accordance with the rules of equity practice, and in any such case the Attorney General, the district attorney or the solicitor of any municipality shall not be required to give bond.

SECTION 602. PENALTIES

(a) Any person or municipality who violates any provision of this act or any rule or regulation or order of the board or any order of the department issued pursuant to this act is guilty of a summary offense and, upon conviction, shall be subject to a fine of not less than one hundred dollars ($100) nor more than one thousand dollars ($1,000) for each separate offense, and, in default of the payment of such fine, the person, or if such person be a partnership, then the members thereof, or if such person be a corporation or association, then the officers, members, agents, servants or employes thereof, shall be imprisoned in the county jail for a period of sixty days.

(b) Any person or municipality who, after a conviction in a summary proceeding within two years as above provided, violates any provision of this act or any rule or regulation or order of the board or any order of the department issued pursuant to this act is guilty of a misdemeanor and, upon conviction, shall be subject to a fine of not less than one hundred dollars ($100) nor more than five thousand dollars ($5,000) for each separate offense or to imprisonment in the county jail for a period of not more than one year, or both. In the case of a partnership the members thereof, and in the case of a corporation or an association the officers, members, agents, servants or employes thereof, may be subject to any such sentence of imprisonment.

(c) Each day of continued violation of any provision of this act or any rule or regulation or order of the board or any order of the department issued pursuant to this act shall constitute a separate offense under subsections (a) and (b) of this section.

SECTION 603. SUMMARY PROCEEDINGS

All summary proceedings under the provisions of this act may be brought before any magistrate, alderman or justice of the peace of the county where the offense occurred or the unlawful discharge of sewage, industrial waste or pollution was maintained, or in the county where the public is affected, and to that end jurisdiction is hereby conferred upon said magistrates, aldermen or justices of the peace, subject to appeal by either party in the manner provided by law. In the case of any appeal from any such conviction in the manner provided by law for appeals from summary conviction, it shall be the duty of the district attorney of the county to represent the interests of the Commonwealth.

SECTION 604. COMPLAINTS; INVESTIGATIONS

Upon complaint made in writing by any responsible person to the board, it shall be the duty of the board through its agents to investigate any alleged source of pollution of the waters of the Commonwealth, and to institute appropriate proceedings under the provisions of this act to discontinue any such pollution if the offense complained of constitutes a violation of the provisions of this act.

SECTION 605. CIVIL PENALTIES

In addition to proceeding under any other remedy available at law or in equity for a violation of a provision of this act or a rule or regulation of the board or an order of the department, the board, after hearing, may assess a civil penalty upon a person or municipality for such violation. Such a penalty may be assessed whether or not the violation was wilful. The civil penalty so assessed shall not exceed ten thousand dollars ($10,000), plus five hundred dollars ($500) for each day of continued violation. In determining the amount of the civil penalty the board shall consider the wilfullness of the violation, damage or injury to the waters of the Commonwealth or their uses, cost of restoration, and other relevant factors. It shall be payable to the Commonwealth of Pennsylvania and shall be collectible in any manner provided at law for the collection of debts. If any person liable to pay any such penalty neglects of refuses to pay the same after demand, the amount, together with interest and any costs that may accrue, shall be a lien in favor of the Commonwealth upon the property, both real and personal, of such person but only after same has been entered and docketed of record by the prothonotary of the county where such is situated. The board may, at any time, transmit to the prothonotaries of the respective counties certified copies of all such liens, and it shall be the duty of each prothonotary to enter and docket the same of record in his office, and to index the same as judgments are indexed, without requiring the payment of costs as a condition precedent to the entry thereof.

SECTION 606. PROCEEDINGS WHERE WATERS POLLUTED FROM MANY SOURCES

Nothing contained in the laws of the Commonwealth shall estop the board from proceeding under the provisions of this act against any particular municipality or person discharging sewage or industrial waste or other noxious or deleterious substance into the waters of the Commonwealth even though said waters are, at the time, polluted from other sources.

SECTION 607. PUBLIC RECORDS; EVIDENCE

All papers, records, and documents of the board, and applications for permits pending before the board, shall be public records open to inspection during business hours, and copies of all such public records and the rules and regulations of the board, certified by the Secretary of Health, shall be received in evidence in all courts and elsewhere.

SECTION 608. EXISTING RULES, REGULATIONS, AND ORDERS

All rules and regulations heretofore adopted by the board and all orders made and actions taken by the board or the Secretary of Health under the provisions of law repealed by this act, shall continue in force with the same effect as if such laws had not been repealed, subject, however, to modification, change or annulment, as may be deemed necessary by the board, in order to comply with the provisions of this act.

SECTION 609. WITHHOLDING OF PERMIT

The department may withhold the issuance of any permit required by this act when the applicant has been found to be in violation of any relevant provision of this act, or of any relevant rule, regulation or order of the board, or of any relevant order of the department, and that the said violation demonstrates a lack of ability or intention on the part of the applicant to comply with the law or with the conditions of the permit sought. In such case, the department shall forthwith notify the applicant in writing of the grounds for withholding issuance of the permit, setting forth in reasonable detail the nature of the violation and affording the applicant a prompt opportunity to appear before the board and be heard. Should the applicant wish to do so, he may offer evidence of his ability and intention to comply with the provisions of this act and the rules, regulations and orders of the board and of the conditions of the permit notwithstanding such violation, and should the department be satisfied, it may in its discretion grant said permit under such terms and conditions as it may deem necessary.

SECTION 610. ENFORCEMENT ORDERS

The department may issue such orders as are necessary to aid in the enforcement of the provisions of this act. Such orders shall include, but shall not be limited to, orders modifying, suspending or revoking permits and orders requiring persons or municipalities to cease operations of an establishment which, in the course of its operation, has a discharge which is in violation of any provision of this act. Such an order may be issued if the department finds that a condition existing in or on the operation involved is causing or is creating a danger of pollution of the waters of the Commonwealth, or if it finds that the permittee, or any person or municipality is in violation of any relevant provision of this act, or of any relevant rule, regulation or order of the board or relevant order of the department: Provided, however, That an order affecting an operation not directly related to the condition or violation in question, may be issued only if the department finds that the other enforcement procedures, penalties and remedies available under this act would probably not be adequate to effect prompt or effective correction of the condition or violation. The department may, in its order, require compliance with such conditions as are necessary to prevent or abate pollution or effect the purposes of this act. An order issued under this section shall take effect upon notice, unless the order specifies otherwise. An appeal to the board of the department's order shall not act as a supersedeas: Provided, however, That, upon application and for cause shown, the board or the Commonwealth Court may issue such a supersedeas. The right of the department to issue an order under this section is in addition to any penalty which may be imposed pursuant to this act. The failure to comply with any such order is hereby declared to be a nuisance.

ARTICLE VII

SCOPE AND PURPOSE

SECTION 701. EXISTING RIGHTS AND REMEDIES PRESERVED

The collection of any penalty under the provisions of this act shall not be construed as estopping the Commonwealth, or any district attorney or solicitor of a municipality, from proceeding in courts of law or equity to abate pollutions forbidden under this act, or abate nuisances under existing law. It is hereby declared to be the purpose of this act to provide additional and cumulative remedies to abate the pollution of the waters of this Commonwealth, and nothing in this act contained shall in any way abridge or alter rights of action or remedies now or hereafter existing in equity, or under the common law or statutory law, criminal or civil, nor shall any provision in this act, or the granting of any permit under this act, or any act done by virtue of this act, be construed as estopping the Commonwealth, persons or municipalities, in the exercise of their rights under the common law or decisional law or in equity, from proceeding in courts of law or equity to suppress nuisances, or to abate any pollution now or hereafter existing, or enforce common law or statutory rights.

ARTICLE VIII

REPEALER

SECTION 801. REPEAL

The following acts and parts of acts of Assembly are hereby repealed:

Sections four, five, six, seven, eight, nine, ten, and eleven of an act, approved the twenty-second day of April, one thousand nine hundred and five (Phamphlet Laws, two hundred sixty), entitled "An act to preserve the purity of the waters of the State for the protection of the public health."

The act approved the fourteenth day of June, one thousand nine hundred and twenty-three (Phamphlet Laws, seven hundred ninety-three), entitled "An act to preserve the purity of the sources of public water supplied hereafter approved; authorizing the Advisory Board of the Department of Health to make orders and regulations therefor, and the Commissioner of Health to enforce the same; providing penalties for violation thereof, and for abatement of nuisances by injunction."

All other acts and parts of acts inconsistent with the provisions of this act are hereby repealed.

ARTICLE IX

SHORT TITLE

SECTION 901. SHORT TITLE

This act shall be known and may be cited as "The Clean Streams Law."

ARTICLE X

SEVERABILITY CLAUSE

SECTION 1001. SEVERABILITY CLAUSE

The provisions of this act shall be severable. If any provision of this act is found by a court of record to be unconstitutional and void, the remaining provisions of the act shall, nevertheless, remain valid unless the court finds the valid provisions of the act are so essentially and inseparably connected with, and so depend upon, the void provision, that it cannot be presumed the legislature would have enacted the remaining valid provisions without the void ones; or unless the court finds the remaining valid provisions standing alone, are incomplete and are incapable of being executed in accordance with the legislative intent.

Note - Section 18 of the Act of July 31, 1970, (Act 222) provided:

> "All rules, regulations, orders and permits, heretofore adopted or issued by the Sanitary Water Board or the Department of Health of the Commonwealth of Pennsylvania under the provisions of law repealed by this act, shall continue in force with the same effect as if such provisions of law had not been repealed subject, however, to such modification, change or annulment as may be deemed necessary by the Sanitary Water Board of the Department of Health or the Department of Mines and Mineral Industries in order to comply with the provisions of this act."

TITLE 25. RULES AND REGULATIONS
PART I. DEPARTMENT OF ENVIRONMENTAL RESOURCES

TRANSMITTAL SHEET NO. 8

November 1972

Transmitted herewith are additional or substitute pages to the Rules and Regulations of the Department of Environmental Resources, identified by the month and year of revision, which contain additions or amendments as a result of the action taken by the Environmental Quality Board. The nature of the changes may be determined by comparing the old and new texts.

Section Affected	*Action Taken*	*Date of Adoption*	*Effective Date*	*Pa. Bulletin Citation*
Chapter 102				
§§ 102.10-102.61	Added	9/21/72	10/21/72	1 Pa.B. 1796

Instructions

Insert the attached pages
102.1 - 102.5

Note

File this transmittal sheet at the front of the Rules and Regulations of the Department (Part I) and retain prior transmittal sheets. It provides a reference authority for changes, a method for determining that all amendments have been received, and a check for determining if the Rules and Regulations contain the proper pages. Additional information may be obtained from the Bureau of Legal Services, Department of Environmental Resources, 219 Towne House, P.O. Box 2063, Harrisburg, PA 17105 (Telephone Area Code 717 787-1956).

TITLE 25. RULES AND REGULATIONS
PART I. DEPARTMENT OF ENVIRONMENTAL RESOURCES
Subpart C. PROTECTION OF NATURAL RESOURCES
ARTICLE II. WATER RESOURCES

CHAPTER 102. EROSION CONTROL

Authority

The provisions of this Chapter 102 issued under act of June 22, 1937, P.L. 1987, § § 5 and 402 (35 P.S. § § 691.5 and 691.402).

Source

The provisions of this Chapter 102 adopted September 21, 1972.

GENERAL PROVISIONS

§ 102.10. Purpose.

The purpose of this Chapter is to control accelerated erosion and the resulting sedimentation of waters of this Commonwealth thereby preventing the pollution of such waters from sediment and from fertilizers, pesticides and other polluting substances carried by sediment.

§ 102.11. Scope.

The provisions of this Chapter impose requirements on earthmoving activities which create accelerated erosion or a danger of accelerated erosion and which require planning and implementation of effective soil conservation measures.

§ 102.13. Definitions.

The following words and terms, when used in this Chapter, shall have the following meanings, unless the context clearly indicates otherwise:

(1) *Accelerated erosion* - The removal of the surface of the land through the combined action of man's activities and the natural processes at a rate greater than would occur because of the natural process alone.

(2) *Department* - The Department of Environmental Resources of the Commonwealth.

(3) *Diversion terrace* - A channel or dike constructed up slope of a project for the purpose of diverting storm water away from the unprotected slope.

(4) *Earthmoving activity* - Any construction or other activity which disturbs the surface of the land including, but not limited to, excavations, embankments, land development, subdivision development, mineral extraction and the moving, depositing or storing of soil, rock or earth.

(5) *Embankment or fill* - A deposit of soil, rock, or other material placed by man.

(6) *Erosion* - The natural process by which the surface of the land is worn away by the action of water, wind or chemical action.

(7) *Excavation* - A cavity formed by digging, quarrying, uncovering, displacing, or relocating soil or rock.

(8) *Interceptor channel* - A channel or dike contructed across a slope for the purpose of intercepting storm water, reducing the velocity of flow, and diverting it to outlets where it can be disposed.

(9) *Land developer* - Any person who is engaged in land development as the principal rather than an agent or contractor.

(10) *Land development* - The constructing, installing, placing, planting, or building of surface structures, utility lines, shopping centers and malls, golf courses, apartment complexes, schools, roads, highways, parking areas or any other similar activity.

(11) *Sediment* - Soils or other surficial materials transported by surface water as a product of erosion.

(12) *Sedimentation* - The process by which sediment is deposited on stream bottoms.

(13) *Stabilization* - The proper placing, grading and/or covering of soil, rock or earth to insure their resistance to erosion, sliding, or other movement.

(14) *Subdivision* - The division or redivision of a lot, tract, or parcel of land by any means into two or more lots, tracts, parcels or other division of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, transfer of ownership or building or lot development.

§ 102.14. General Requirement.

All earthmoving activities within this Commonwealth shall be conducted in such a way as to prevent accelerated erosion and the resulting sedimentation. To accomplish this, all persons engaged in earthmoving activities shall design, implement and maintain erosion and sedimentation control measures which effectively prevent accelerated erosion and sedimentation. These erosion and sedimentation measures must be set forth in a plan as described in § 102.15 of this Title and must be available at all times at the site of the activity. The Department or its designee may, at its discretion, require this plan to be filed with the Department or its designee.

§ 102.15. Erosion and Sedimentation Control Plan.

(a) The erosion and sedimentation control plan shall be prepared by a person trained and experienced in erosion and sedimentation control methods and techniques.

(b) The erosion and sedimentation control plan shall be designed to prevent accelerated erosion and sedimentation and shall consider all factors which contribute to erosion and sedimentation including, but not limited to, the following:

(i) The topographic features of the project area.

(ii) The types, depth, slope, and areal extent of the soils.

(iii) The proposed alteration to the area.

(iv) The amount of runoff from the project area and the upstream watershed area.

(v) The staging of earthmoving activities.

(vi) Temporary control measures and facilities for use during earthmoving.

(vii) Permanent control measures and facilities for long term protection; and

(viii) A maintenance program for the control facilities including disposal of materials removed from the control facilities or project area.

EROSION AND SEDIMENTATION CONTROL
MEASURES AND FACILITIES

§ 102.21. General Requirement.

The erosion and sedimentation control facilities set forth in § § 102.22 and 102.23 of this Title (relating to control measures and facilities) shall be appropriately incorporated into all earthmoving activities unless the designer of the erosion and sedimentation control plan shows that alteration of these measures and facilities or inclusion of other measures and facilities will prevent accelerated erosion and sedimentation.

§ 102.22. Control Measures.

(a) *Limiting exposed areas.* All earthmoving activities shall be planned in such a manner as to minimize the areal extent of disturbed land.

(b) *Surface water diversion.* All surface water shall be diverted away from the project area.

(c) *Velocity control.* All permanent facilities for the conveyance of water around through or from the project area shall be designed or contain facilities to limit the velocity of flow in the facilities to less than 1.5 feet per second.

(d) *Stabilization.* All slopes, channels, ditches or any disturbed area shall be stablized as soon as possible after the final grade or final earthmoving has been completed.

(e) *Interim stabilization.* Where it is not possible to permanently stabilize a disturbed area immediately after the final earthmoving has been completed or where the activity ceases for more than 20 days, interim stabilization measures shall be implemented promptly.

(f) *Collection of runoff.* All runoff from a project area shall be collected and diverted to facilities for removal of sediment.

(g) *Solids separation.* Runoff from a project area shall not be discharged to the waters of the Commonwealth without means to prevent sedimentation.

§ 102.23. Control Facilities.

(a) *Diversion Terraces.*

(1) Diversion terraces shall be constructed up-grade of a project area to convey runoff around the project area. For temporary diversion the channel shall have a capacity to convey 1.6 cubic feet per second per acre of land tributary to it. For permanent diversion, the channel shall have a capacity to convey 2.75 cubic feet per second per acre of land tributary to it.

(2) Diversion terraces shall be grassed or lined with erosion resistant material to prevent accelerated erosion within the channel.

(3) Outlet structures shall be designed to maintain a discharge velocity of less than 3.0 feet per second and shall be stabilized before use.

(b) *Interceptor Channels.*

(1) Interceptor channels may be used within a project area to reduce the velocity of flow and thus prevent accelerated erosion.

(2) Water collected by interceptor channels shall be conveyed to sedimentation basins or to vegetated areas but not directly to streams.

(3) Outlets to vegetated areas shall be designed to maintain an outlet velocity of less than 3.0 feet per second.

(c) *Channels of Conveyance.*

(1) All channels used to convey water through a project area shall be designed to have a velocity of less than 1.5 feet per second. Where this in not possible, the channel shall be grassed or lined with erosion resistant material.

(d) *Sedimentation Basins.*

(1) A sedimentation basin shall have a capacity of 7,000 cubic feet for each acre of project area tributary to it and shall be provided with a 24-inch freeboard.

(2) The basin shall be cleaned when the storage capacity of the basin is reduced to 5,000 cubic feet per acre of project area tributary to it.

(3) Outlet structures shall be designed to pass a minimum flow of 2.0 cubic feet per second for each acre of project area tributary to the basin.

(4) The discharge from a sedimentation basin shall be to a natural waterway.

(5) Sedimentation basins shall be structurally sound and protected from unauthorized acts of third parties.

RESTORATION

§ 102.31. Applicability.

The provisions of § § 102.31 - 102.34 of this Title (relating to restoration) shall apply to all earthmoving activities which have not been stabilized.

§ 102.32. Stabilization.

Upon completion of the project, all areas which were disturbed by the project shall be stablilized so that accelerated erosion will be prevented.

§ 102.33. Interim Control Measures.

Any erosion and sedimentation control facility required or necessary to protect areas from erosion during the stabilization period shall be maintained until stablization is completed.

§ 102.34. Final Measures.

Upon completion of stabilization, all unnecessary or unusable control facilities shall be removed, the areas shall be graded and the soils shall be stabilized.

PERMITS AND PLANS

§ 102.41. Permit Requirements.

(a) Any person who engages in an earthmoving activity within the Commonwealth shall obtain a permit prior to commencement of the activity except a permit will not be required:

(1) where the earthmoving activity involves plowing or tilling for agricultural puposes;

(2) where an erosion and sedimentation control plan has been developed for an earthmoving activity by the U.S.D.A. Soil Conservation Service;

(3) where an activity is required to obtain a permit pursuant to the Clean Streams Law (35 P.S. § 691.1 *et. seq.*), the Surface Mining and Reclamation Act (52 P.S. § 1396.1 *et. seq.*), the Water Obstruction Act (32 P.S. § 681 *et. seq.*) or the provisions of Chapter 91 - 101 of this Title (relating to water pollution);

(4) where an earthmoving activity affects less than 25 acres.

(b) The Department, after publication in the Pennsylvania Bulletin, can reduce the acreage limitation set forth in § 102.41 (a) 4:

(1) on a statewide basis at its discretion;

(2) for special areas where the Department deems it necessary;

(3) for any county or municipality within the Commonwealth.

(c) Even though an activity is not required to obtain a permit under the exceptions described herein, the person undertaking the activity shall comply with the other provisions of the Chapter.

§ 102.42. Application for Permit.

(a) Applications for permits shall be submitted by the person undertaking the earthmoving activity. In the case of land development, the application shall be submitted by the land developer rather than the contractor or agent.

(b) Applications shall be accompanied by an erosion and sedimentation control plan and such other documents as the Department may require.

(c) Applications shall be accompanied by a processing fee of $200.00.

RESPONSIBILITIES OF LOCAL GOVERNING BODIES

§ 102.51. Administration by Local Governing Bodies.

(a) The Department may, at its discretion, delegate the administration and enforcement of this Chapter to counties and other units of local government provided the county or other unit of local government has and implements an acceptable plan approved by the Department for administering such a program.

(b) An acceptable plan includes adequate and qualified staff for the review of erosion and sediment control plans and for the surveillance and enforcement of this Chapter. An acceptable plan must have the concurrence and approval of the Commissioners of the county in which the local unit of government operates.

(c) The Department will retain program administration over any projects which cross the political boundaries of local governing bodies who have been delegated the administration of these regulations.

§ 102.52. Notification of application for building permits.

Any local governing body which issues building permits shall notify the Department or its designee immediately upon receipt of an application for a building permit involving an earthmoving activity which affects five acres or more of land.

§ 102.53. Withholding building permits.

A local governing body shall not issue a building permit to those engaged in earthmoving activities requiring a Department permit until the Department has issued the permit pursuant to § § 102.41 - 102.42 of this Title (relating to permit requirements).

IMPLEMENTATION OF CHAPTER 102

§ 102.61. Effective dates.

(a) The provisions of these regulations shall become effective 30 days after their adoption by the Environmental Quality Board except that the provision (§ § 102.41 - 102.42) which requires permits prior to the commencement of an activity shall become effective on July 1, 1973, and the provision in § 102.14 which requires preparation of erosion and sedimentation control plans shall become effective according to the following schedule:

(1) Agricultural activities (plowing and tilling only) - July 1, 1977.

(2) All existing earthmoving activities - January 1, 1974.

(3) All new earthmoving activities started after adoption of these regulations but before July 1, 1973 - July 1, 1973.

(4) All new earthmoving activities started after July 1, 1973 - prior to commencement of the activity.

(b) The Department, where it finds that it is in the best interest of the Commonwealth, may order the development and implementation of erosion and sedimentation control plans or require permits sooner than the dates indicated in § 102.61.

Act No. 347
Public Acts of 1972
Approved by Governor
January 9, 1973

STATE OF MICHIGAN
76TH LEGISLATURE
REGULAR SESSION OF 1972

Introduced by Reps. Copeland, Goemaere, Smit, Pilch, Stallworth, Morris W. Hood, Jr., Fitzgerald, Thomas J. Anderson and Loren D. Anderson

Enrolled House Bill No. 4709

AN ACT to provide for the control of soil erosion and to protect the waters of the state from sedimentation to prescribe the powers, duties and functions of state and local agencies; to provide for the promulgation of rules; and to provide remedies and penalties.

The People of the State of Michigan enact:

Sec. 1. This act shall be known and may be cited as the "soil erosion and sedimentation control act of 1972".

Sec. 2. (1) "Agricultural practices" means land tillage operations necessarily associated with the planting and harvesting of crops.

(2) "Authorized public agency" means a state, local or county agency designated pursuant to section 11 to enforce soil erosion and sedimentation control requirements with regard to land uses undertaken by it.

(3) "Commission" means the water resources commission of the department of natural resources.

(4) "County agency" means an officer, board, commission, department or other entity of county government.

(5) "County enforcing agency" means an agency designated by a county board of commissioners pursuant to section 6.

(6) "Department" means the state department of agriculture.

(7) "Earth change" means a man-made change in the natural cover or topography of land, including cut and fill activities, which may result in or contribute to soil erosion or sedimentation of the waters of the state.

(8) "Land use" means a use of land which may result in an earth change, including but not limited to subdivision, residential, commercial, industrial, recreational or other development, private and public highway, road and street construction, drainage construction, logging operations, agricultural practices and mining.

(9) "Local agency" means a county, city, village or charter township.

(10) "Local enforcing agency" means an agency designated by a city, village or charter township in accordance with section 7.

(11) "Person" means a natural person, firm, corporation, partnership or association.

(12) "Public agency" means a general law township, a school board or any other local or regional public body, authority, board or commission which is not a state, local or county agency.

(13) "Rules" means the rules promulgated pursuant to section 5.

Sec. 3. (1) "Sediment" means solid particulate matter, mineral or organic, that has been deposited in water, is in suspension in water, is being transported, or has been removed from its site of origin by the processes of soil erosion.

(2) "Soil conservation district" means a soil conservation district authorized by section 5 of Act No. 297 of the Public Acts of 1937, as amended, being section 282.5 of the Compiled Laws of 1948.

(3) "Soil erosion" means the wearing away of land by the action of wind, water, gravity or a combination thereof.

(4) "State agency" means a principal state department.

Sec. 4 . (1) By July 1, 1973, the department, with the assistance of the soil conservation districts and in consultation with appropriate state and local agencies shall prepare and submit to the commission for the commission's approval a unified statewide soil erosion and sedimentation control program. The program shall identify land uses which may be governed by this act and shall include recommendations, guidelines and specifications for the control of soil erosion for the identified land uses to prevent sedimentation of the waters of this state. The program shall also set forth the means by which agricultural practices shall, by January 1, 1979, be in compliance with the guidelines and specifications as set forth therein.

(2) The commission shall make available to the department:

(a) Information on the effects of sediments on water quality and the damages of water resources that may be attributed thereto.

(b) The location of those waters of this state which are degraded or have potential for being degraded by sedimentation.

(c) Water quality standards which shall be included in the program to protect the designated uses of the waters of this state.

Sec. 5. (1) By October 1, 1973, the commission, with the assistance of the department, shall prepare rules for a unified soil erosion and sedimentation control program including provisions for the review and approval of site plans, land use plans or permits relating to erosion control and sedimentation control. The commission shall notify and make copies of the proposed rules available to state, local, county and public agencies affected by this act for review and comment before promulgation.

(2) The commission shall promulgate the rules in accordance with and subject to Act No. 306 of the Public Acts of 1969, as amended, being sections 24.201 to 24.315 of the Compiled Laws of 1948. The rules take effect on July 1, 1974.

Sec. 6. (1) A county is responsible for the administration and enforcement of the rules throughout the county except within a city, village or charter township that has in effect an ordinance conforming to the provisions of this section and except with regard to land uses of authorized public agencies approved by the commission pursuant to section 11 and except with regard to agricultural practices prior to January 1, 1979.

(2) By April 1, 1974, the county board of commissioners, by resolution, shall designate a county agency as the county enforcing agency responsible for administration and enforcement in the name of the county. The resolution may set forth a schedule of fees for inspections, plan reviews and permits and may set forth other matters relating to the administration and enforcement of this act and the rules. A copy of the resolution and all subsequent amendments thereto shall be forwarded to the commission.

(3) Two or more counties may provide for joint enforcement and administration by entering into an interlocal agreement pursuant to Act No. 7 of the Public Acts of the Extra Session of 1967, being sections 124.501 to 124.512 of the Compiled Laws of 1948.

Sec. 7. (1) A city, village or charter township by ordinance may provide for soil erosion and sedimentation control on public and private land uses within its boundaries except that a charter township ordinance shall not be applicable within a village that has in effect an ordinance providing soil erosion and sedimentation control. An ordinance may be more restrictive but may not make lawful that which is unlawful under this act and the rules. The ordinance may adopt all or part of the rules by reference, shall designate a local enforcing agency responsible for administration and enforcement of the ordinance and may set forth such other matters as the legislative body deems necessary or desirable. The ordinance shall be applicable and shall be enforced with regard to all private and public land uses within the city, village or charter township except land uses of an authorized public agency designated pursuant to section 11. The city, village or charter township may consult with a soil conservation district for assistance or advice in the preparation of the ordinance.

(2) On July 1, 1975, an ordinance which is not approved by the commission as conforming to the minimum requirements of this act and the rules shall have no force or effect. With regard to a city, village or charter township ordinance in effect prior to July 1, 1974, a copy of the ordinance shall be submitted to the commission before September 1, 1974. With regard to an ordinance or an amendment proposed to be adopted on or after July 1, 1974, a copy of the proposed ordinance or proposed amendment shall be submitted to the commission for approval before adoption. The commission shall forward

a copy to the appropriate soil conservation district for review and comment. Within 90 days after it receives an existing ordinance, proposed ordinance or amendment, the commission shall notify the clerk of the city, village or charter township of its approval or disapproval along with recommendations for revision to the extent that the ordinance, proposed ordinance or amendment does not conform to the minimum requirements of this act or the rules. If the commission does not so notify the clerk of the local unit within the 90-day period, the ordinance, proposed ordinance or amendment shall be deemed to have been approved by the commission.

Sec. 8. A county or local enforcing agency shall notify the commission of all violations of this act or the rules or violations of the ordinance, including violations attributable to a land use by an authorized public agency.

Sec. 9. As a condition for the issuance of a permit, the county or local enforcing agency may require the applicant to deposit with the clerk of the local agency in the form of cash, a certified check or an irrevocable bank letter of credit, whichever the applicant selects, or a surety bond acceptable to the legislative body of the local agency, in an amount sufficient to assure the installation and completion of such protective or corrective measures as may be required by the county or local enforcing agency.

Sec. 10. (1) An authorized public agency or a county or local enforcing agency may enter into an agreement with a soil conservation district for assistance and advice in overseeing and reviewing compliance with adequate soil erosion and sedimentation control procedures and in reviewing existing or proposed land uses, land use plans or site plans with regard to technical matters pertaining to soil erosion and sedimentation control.

(2) A person engaged in agricultural practices may enter into agreement with the appropriate soil conservation district to pursue such agricultural practices in accordance with and subject to the rules promulgated by the commission pursuant to section 5. Where a person enters into an agreement with a soil conservation district, the district shall notify the county or local enforcement agency or the commission thereof. Upon formal agreement and in compliance with the provisions of this act as provided in this subsection, a person shall not be subject to any site plans, land use plans, or permits required pursuant to this act, but shall be subject to enforcement as provided by sections 13 and 14 after January 1, 1979.

Sec. 11. (1) A state, local or county agency may apply to the commission for designation as an authorized public agency by submitting to the commission the soil erosion and sedimentation control procedures governing all land uses normally undertaken by the agency. If the applicant is a local or county agency, the commission shall submit the procedures to the appropriate soil conservation district for review, which shall submit its comments thereon to the commission within 60 days. If the applicant is a state agency, the commission shall submit the procedures to the department for review, which shall submit its comments thereon to the commission within 60 days.

(2) If the commission finds that a local agency's soil erosion and sedimentation control procedures are adequate, the commission may delegate to that local agency authority to approve local or county agency soil erosion and sedimentation control procedures and designate the local or county agency as an authorized public agency.

(3) After approval of the procedures and designation as an authorized

public agency pursuant to subsection (1) or (2), all affected land uses maintained or undertaken by the authorized public agency shall be undertaken pursuant to the approved procedures. If determined necessary by the commission and upon request of an authorized agency, the commission may grant a variance from the provisions of this subsection.

Sec. 12. (1) After June 30, 1974, a person who makes and submits a preliminary plat pursuant to sections 111 to 118 of Act No. 288 of the Public Acts of 1967, as amended, being sections 560.111 to 560.118 of the Compiled Laws of 1948, shall attach a statement that he will comply with this act and the rules or an applicable local ordinance.

(2) After June 30, 1974, in addition to the statements in the proprietor's certificate on a final plat as required by section 144 of Act No. 288 of the Public Acts of 1967, as amended, being section 560.144 of the Compiled Laws of 1948, the proprietor's certificate shall include a certificate that he has obtained a permit from the appropriate county or local enforcing agency and will conform to the requirements of this act and the rules or an applicable local ordinance.

Sec. 13. (1) After June 30, 1974, a person shall not maintain or undertake a land use or earth change governed by this act or the rules, or governed by an applicable local ordinance, except in accordance with this act and the rules or with the applicable local ordinance and pursuant to a permit approved by the appropriate county or local enforcing agency. A person who violates this subsection is guilty of a misdemeanor.

(2) When in the opinion of the commission a person or a state, local, county or public agency violates this act, the rules or an applicable local ordinance, or an appropriate local agency fails to enforce this act, the rules or an applicable local ordinance, the commission may notify the alleged offender of its determination. The notice shall contain in addition to a statement of the specific violation which the commission believes to exist, a proposed form of order, stipulation for agreement or other action which the commission deems appropriate to assure timely correction of the violation and shall set a date for a hearing not less than 4 nor more than 8 weeks from the date of the notice of determination. Extensions of the date of the hearing may be granted by the commission or on request. At the hearing, any interested party may appear, present witnesses and submit evidence. A person, state, local, county or public agency who has been served with a notice of determination may file a written answer thereto before the date set for hearing or at the hearing may appear and present oral or written testimony and evidence on the charges and proposed requirements of the commission to assure correction of the violation contained therein. If a person, state, local, county or public agency served with the notice of determination agrees with the proposed requirements of the commission and notifies the commission thereof before the date set for the hearing, disposition of the case may be made with the approval of the commission by stipulation or consent order without further hearing. The final order of determination following the hearing, or the stipulation or consent order as authorized by this section and approved by the commission, is conclusive unless reviewed in accordance with Act No. 306 of the Public Acts of 1969, as amended, in the circuit court of the county of Ingham, or of the county in which the violation occurred, upon petition therefor filed within 15 days after the service upon the person, state, local, county or public agency of the final order of determination.

Sec. 14. (1) Notwithstanding the existence or pursuit of any other remedy, except as provided in section 10, the commission, or any local or county enforcing agency may maintain an action in its own name in a court of competent jurisdiction for an injunction or other process against any person to restrain or prevent violations of this act, the rules or an applicable local ordinance.

(2) The commission or any agent duly appointed by it or any county or local enforcement agency may enter at all reasonable times in or upon any private or public property for the purpose of inspecting and investigating conditions or practices which may be in violation of this act, the rules or an applicable local ordinance.

Sec. 15. In order to carry out their functions under this act, the commission and the department may promulgate additional rules in accordance with and subject to Act No. 306 of the Public Acts of 1969, as amended.

Sec. 16. This act does not apply to land on which a person, partnership or corporation is engaged in the industry generally referred to as logging or is engaged in the industry generally referred to as mining.

Sec. 17. This act shall take effect January 1, 1973.

Thos. Thatcher
Clerk of the House of Representatives.

Beryl I. Kenyon
Secretary of the Senate.

Approved______________________________

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Governor.

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